ACUREX FINAL REPORT 81-76/EE

BASEWIDE ENERGY SYSTEMS PLAN
FORT ORD/PRESIDIO OF MONTEREY
FINAL REPORT

Volume 1

Executive Summary

July 1982

Acurex Project 6033
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REVISIONS TO REPORT

This final report documents the results of a study to develop a Baseside Energy Systems Plan for Fort Ord and the Presidio of Monterey, California. Major changes from the Draft Final Report were the revision, reorganization, and addition of ECIP projects.

As agreed to in the Draft Final review meeting, changes in the text were limited to review comments only. No changes have been made to tables or text due to the new ECIP projects or groupings. However, these new ECIP projects were documented in the Draft Final Report either as ECIP or Increment G projects.

The programming documents contained in Volume IV were completely revised and reorganized. The accompanying table itemizes the 14 ECIP projects and recommended groupings for submission. Identified in this table are cost, energy savings, energy-to-cost and benefit-to-cost (E/C and B/C) ratios, and payback period.

In Volume I, Section 2.2.1, 2.2.2, and 2.2.4 discuss the old ECIP and Increment G projects while Tables 2-10, 2-11, and 2-12 also refer to the original projects. The analogous sections for the Presidio of Monterey are 3.2.1, 3.2.2, and 3.2.4, while the analogous tables are 3-7, 3-8, and 3-9. This information is summarized in Section 4, Table 4-1 for the original 10 projects. Table 4-1 is replaced by the accompanying table which describes the new ECIP project.

Other references to the original ECIP and Increment G projects are contained in Volume IIA and Volume IIIA. Respective sections and tables which were not changed in Volume IIA are: Sections 2.3.1, 2.4.1, 3.3, 3.4, 4.3.1, and 4.3.2; and Tables 2-8, 3-8, 4-1, 4-2, and 4-3. Respective sections and tables which were not changed in Volume IIIA are: Sections 2.3.1, 2.4.1, 3.3, 3.4, 4.3.1, and 4.3.2; and corresponding Tables 2-6, 3-4, 4-1, 4-2, and 4-3.

Project	Cost ($K)	Energy Savings (MBtu/yr)	Cost Savings ($K/yr)	E/C	B/C	Payback period (yrs)
1. a) Install waterflow restrictors, family housing (Fort Ord) b) Replace louvered windows with sliding windows, family housing (Fort Ord) Group Totals	164	38,895	291	238	22.2	0.6
2. a) Install waterflow restrictors, nonfamily housing (Fort Ord) b) Install foam caulking in temporary buildings (Fort Ord) Group Totals	143	33,076	327	227	27.2	0.5
3. a) Install waterflow restrictors, nonfamily housing (Presidio of Monterey) b) Weatherstrip windows (Presidio of Monterey) Group Totals	103	12,631	151	124	16.4	0.7
4. a) Adjust boiler controls (Fort Ord) b) Install boiler air preheat ducts (Fort Ord) c) Install boiler sequence programmers (Fort Ord) d) Replace burners and control systems (Presidio of Monterey) Group Totals	151	8,520	84	56.1	2.81	1.8

Project	Cost ($K)	Energy Savings (MBtu/yr)	Cost Savings ($K/yr)	E/C	B/C	Payback period (yrs)
5. a) Convert to infrared and small unit heaters (Fort Ord) b) Install atmospheric desuperheating/ subcooling coil (Fort Ord) Group Totals	142	5,964	59	42.1	3.60	2.4
6. Insulate bare pipes (Fort Ord)	101	3,112	31	31.0	2.66	3.3
7. a) Install waterflow restrictors, family housing (Presidio of Monterey) b) Install foam caulking, family housing (Presidio of Monterey) c) Insulate walls (Presidio of Monterey) Group Totals	119	2,805	30	23.6	3.37	4.0
8. a) Expand EMCS (Fort Ord) b) Install Microprocessor-Based energy controller (Fort Ord) Group Totals	465	10,804	153	23.3	3.97	3.0
9. a) Insulate laundry pipes, presses, and dryers (Fort Ord) b) Weatherstrip windows (Fort Ord) Group Totals	137	2,799	28	20.6	1.76	4.9
10. Convert incandescent interior lighting to flourescent (Fort Ord)	103	1,587	13	15.4	1.49	7.7

Project	Cost ($K)	Energy Savings (MBtu/yr)	Cost Savings ($K/yr)	E/C	B/C	Payback period (yrs)
11. Convert incandescent street lights to high pressure sodium, nonfamily housing (Fort Ord)	102	1,444	19	14.3	1.92	5.2
12. Convert incandescent street lights to high pressure sodium, family housing (Fort Ord)	220	3,135	41	14.3	1.89	5.3
13. Install swimming pool solar heating system (Fort Ord)	168	2,191	22	13.1	1.61	7.7
14. Expand EMCS (Presidio of Monterey)	182	2,300	23	12.7	1.56	7.8

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SECTION 1

INTRODUCTION

This document is the final report of a study to develop a Basewide Energy Systems Plan for Fort Ord and the Presidio of Monterey, both located in California. Section 1 contains highlights of study results followed by a description of the report organizational format and discussions of the scope of work and methodology used in the study. Sections 2 and 3 present summaries of results for Fort Ord and the Presidio of Monterey, respectively. Section 4 describes the programming documents prepared for projects developed in this study.

1.1 HIGHLIGHTS OF STUDY RESULTS

The objective of this study is to develop a Basewide Energy Systems Plan incorporating a systematic plan of projects to reduce energy consumption in accordance with the goals defined in the Army Facilities Energy Plan or AFEP (Reference 1). Ten Energy Conservation Investment Program (ECIP) projects are presented (some are groupings of sub-projects) with a total annual energy savings of 118,700 MBtu (million British Thermal Units). This represents 5.0 percent of the total 1980 energy consumption for the two installations. Total construction cost for these projects is $1.7 million, and the annual energy cost savings are expected to be $922,000 in the program year (FY84).

Reductions in energy consumption per square foot of building area from FY75 to FY80 have been 14.2 percent and 4.9 percent at Fort Ord and the Presidio of Monterey, respectively. If the ten ECIP projects developed in this study are implemented, further reductions will occur, bringing the total reductions to 23.3 percent and 19.3 percent, respectively, by FY85.

Further reductions due to the following factors are likely by FY85:

- Maintenance, repair and minor construction projects developed in this study will save 34,500 MBtu annually (1.5 percent of the 1980 consumption) at the two installations, if implemented.
- Construction of more energy efficient buildings and subsequent reduced utilization of older buildings will reduce average consumption per square foot.
- Energy management programs dealing with operation and maintenance and consumer awareness issues can potentially save at least as much energy as large projects. The impressive reduction in consumption per square foot achieved from FY75 to FY80 has been almost entirely due to such programs, and more opportunities are available. This report contains recommendations for specific actions to be taken.

The AFEP goal of a 20 percent reduction in energy consumption per square foot from FY75 to FY85 appears certain to be surpassed at both installations if recommendations in this report are implemented. Due to the projected growths in building square footage during this period (38 percent at Fort Ord and 11 percent at Presidio of Monterey), the goal of a 25 percent reduction in the absolute magnitude of consumption is not likely to be realized.

1.2 ORGANIZATION OF REPORT

The report is divided into the following volumes:

Volume I: Executive Summary

Volume IIA: Analysis and Results -- Fort Ord

Volume IIB: Appendices -- Fort Ord

Volume IIIA: Analysis and Results -- Presidio of Monterey

Volume IIIB: Appendices -- Presidio of Monterey

Volume IV: Programming Documents

Volume I contains a general description of the project, a discussion of the methodology used, and a summary of results for both installations. Volumes IIA and IIIA contain the main text of the report: historical and current energy utilization data and the recommended energy plan for each installation. Volumes IIB and IIIB contain appendices: building lists, supporting data/calculations, detailed energy use by building, and field survey sheets. Volume IV contains ECIP project programming documents for both installations.

1.3 SCOPE OF WORK

1.3.1 General

The United States Army Forces Command (FORSCOM) is actively pursuing reduced energy consumption at FORSCOM installations. An overall energy plan has been developed (AFEP) with specific goals of a 20 percent per square foot reduction in consumption and an absolute reduction of 25 percent overall. The baseline year for these goals is FY 75 and the goals are to be achieved by FY 85.

As part of this program, the Corps of Engineers developed a general scope of work for energy conservation studies at FORSCOM Installations. The overall objective of these studies is to develop a systematic plan of

projects which will reduce energy consumption to the goals of the AFEP without decreasing the readiness posture of the Army. The intent of both the AFEP and the scope of work for basewide energy studies is to make the individual installations as energy self-sufficient as possible.

The general scope of work applies to all major installations, in general, with modifications made for each installation through a detailed scope of work. Programmatically, the work is divided into increments as indicated in Table 1-1. This division of work allows incremental funding without detriment to the overall program results. Additionally, each increment is divided into phases of work. For Increments A, B, C and D, the phases of work are:

- Phase I -- Data gathering and field trips
- Phase II -- Analysis of data, identification of Energy Conservation Investment Program (ECIP) projects, feasibility and economic evaluation, preparation of first pages of DD Forms 1391
- Phase III -- Preparation of complete DD 1391's, Project Development Brochures and documents presenting the results and recommendations of the study. This includes the Energy Systems Master Plan documents if requested by the installation.

The phases of work for Increments E, F, and G differ slightly, and DD 1391's are not required. The work, however, still contains field trips, analyses and presentations of results.

1.3.2 Increments of Work

The present study encompasses Increments A, B, and G. The objectives of these Increments are summarized below.

1.3.2.1 Increment A

Increment A projects involve modifying, improving, or retrofitting existing buildings. Architectural, structural, and building systems are included. Projects identified must meet the minimum ECIP criteria, such as energy-to-cost ratio and benefit-to-cost ratio, and minimum cost ($100,000).

Table 1-1. Description of Increments of Work, Energy Engineering Analysis Programs

Increment A -- ECIP[1] projects for buildings and processes
Increment B -- ECIP projects for utilities and energy distribution systems, Energy Monitoring and Control Systems and local use of available waste fuels in existing energy plants
Increment C -- Solar and renewable energy systems not directly connected with Increment A
Increment D -- New Total Energy and Selective Energy plants, coal and POL storage and handling facilities, and waste fuel facilities
Increment E -- Determine the feasibility of installing central boiler plants serving all or discrete parts of each installation
Increment F -- Development of an Energy Management Plan by analyzing all energy uses and needs and by analyzing viable alternative operation activities and uses
Increment G -- Identify maintenance, repair and minor construction projects for energy conservation in addition to ECIP projects

[1]Energy Conservation Investment Program

Programming documents consisting of Form DD 1391 with detailed justification and economic analysis, and a Program Development Brochure (PDB) are to be prepared for each viable ECIP project.

A second objective was to perform for each type of building an energy balance delineating energy consumption and load profile. This includes tabulation of building construction -- itemizing major building components and "U" values; identifying each energy source entering the building; itemizing Btu's used for heating, cooling, and electricity. The analysis of this data provides the basis for accurately estimating the potential savings for recommended ECIP projects.

Also included was the objective to evaluate facilities/buildings which would benefit from the installation of meters: with major energy consumers metering could be used as an incentive for conservation. This could also work in instances where energy is supplied to nongovernment facilities located on base.

1.3.2.2 Increment B

Increment B projects include modifying, repairing or retrofitting existing utilities and energy distribution systems, as well as the Energy Monitoring and Control System (EMCS) and conversion of existing energy plants to waste fuels. Additional objectives are summarized below.

Each type of energy system on the installation is to be analyzed for performance and energy consumption. Specifically, where data existed energy usage is to be developed reflecting consumption annually, monthly, and hourly. These data along with the building energy data collected and estimated in Increment A provides the basis for developing an overall energy picture of the installation, including purchases of each major source of energy as well as disaggregate end-use data. From these data,

load profiles can also be constructed which can then be used to evaluate the effectiveness of conservation projects, and ultimately to develop the most viable energy plan.

Additional items in this portion of the work include projecting energy costs, evaluating future expansion of the existing EMCS, and the evaluation of using waste fuels in existing energy plants. Again, programming documents are to be prepared for each ECIP project developed.

1.3.2.3 Increment G

Increment G projects are maintenance, repair, and minor construction projects identified during Phase III of Increments A and B. Included in the minor construction category are ECIP-type projects which do not satisfy all of the criteria for ECIP funding (e.g., minimum cost). Completed programming documents are not required for projects developed, but sufficient information must be provided to allow the installation to prepare these documents later at its option.

1.4 METHODOLOGY

1.4.1 General Approach

The approach to Increments A and B is shown schematically in Figures 1-1, 1-2 and 1-3 for each of the three phases of work, respectively. Key elements of the approach included a comprehensive field survey; disaggregate energy use analyses*; identification and analyses of ECIP projects for buildings and systems, including prioritization of the most cost-effective measures; and developing a Basewide Energy Systems Plan consistent with FORSCOM objectives. The methodology and actual data collection stressed

*The term "disaggregate energy use", as used throughout this report, refers to a component of the total energy use (e.g., natural gas used for domestic water heating or electricity used for water pumping).

contact with personnel at Fort Ord and the Presidio of Monterey. All efforts were made to coordinate the study with Directorate of Facilities Engineering (DFAE) and the various maintenance and shop organizations.

The approach to Increment G is shown in Figure 1-4. Increment G projects were identified primarily from field information gathered during Phase I of Increments A and B with supplemental field data gathered as required.

Key elements of the approach included data collection, developing overall energy end-use categories (disaggregate end-use data), and performing analysis of these data for potentially viable ECIP projects. It was explicitly assumed that buildings and systems could be grouped according to like uses, and similar or repetitive construction. To a large extent, this assumption is valid for both Fort Ord and the Presidio. This allowed concentration of effort on data collection and subsequent analysis.

Further, the approach during the field survey for each installation was to collect as much data as possible on energy use. This included reading existing meters, reviewing utility bills and shop records. In this manner, these data could be used to verify the overall energy balance calculations and approach. This type of verification provided the accuracy to quantify the savings potential of individual ECIP projects.

Services provided by the conservation department of the local utility (PG&E) were utilized as much as possible. Inspection tours of the Fort Ord Commissary, cold storage plant, laundry and Hays Army Hospital were made and PG&E provided recommendations where appropriate. It was also requested that PG&E perform efficiency tests of boilers at the hospital and laundry and pumps throughout the installation. In addition, it was learned that PG&E has a program to provide free water heater

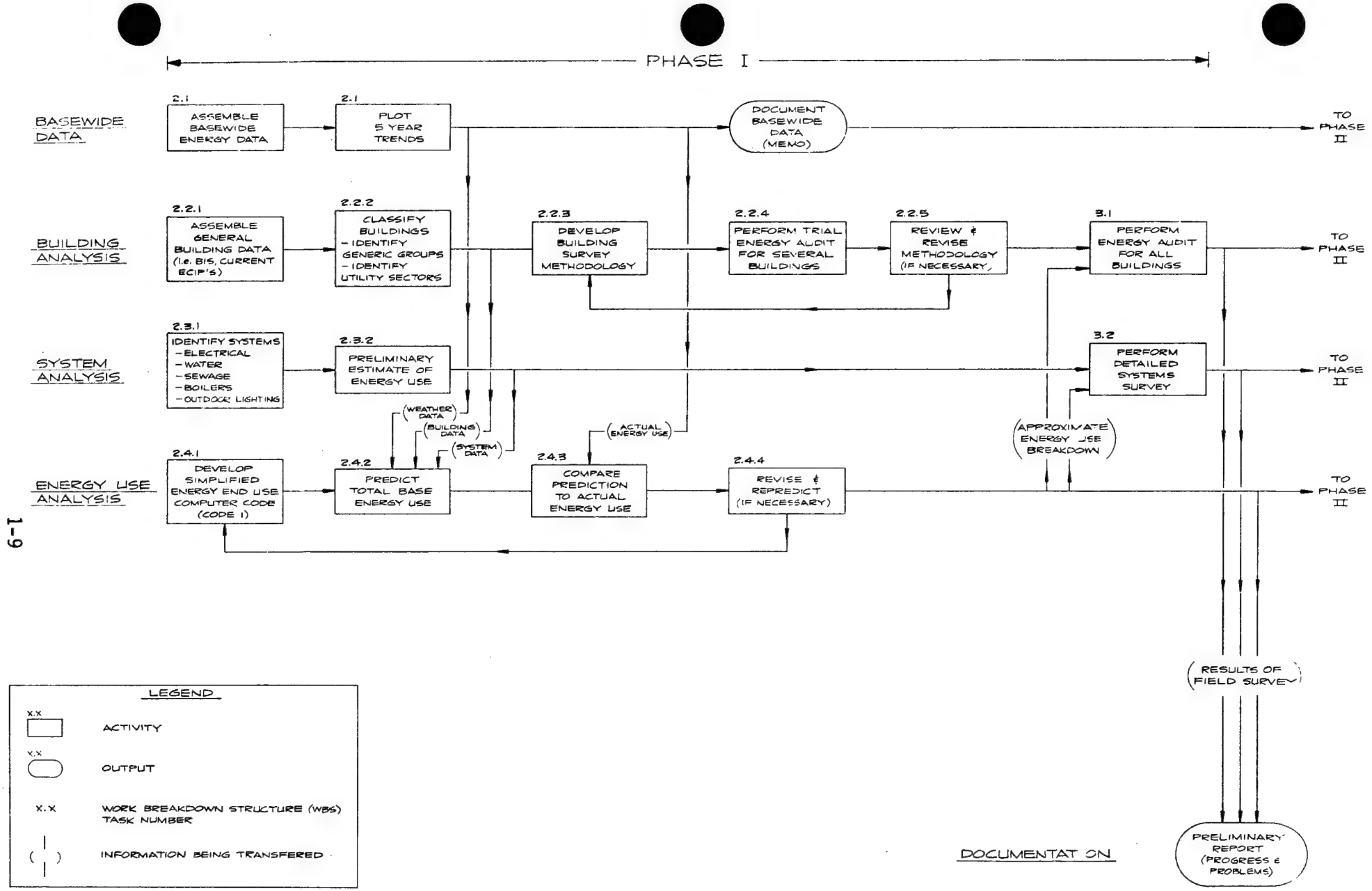

Figure 1-1. Increments A & B -- Phase I Approach

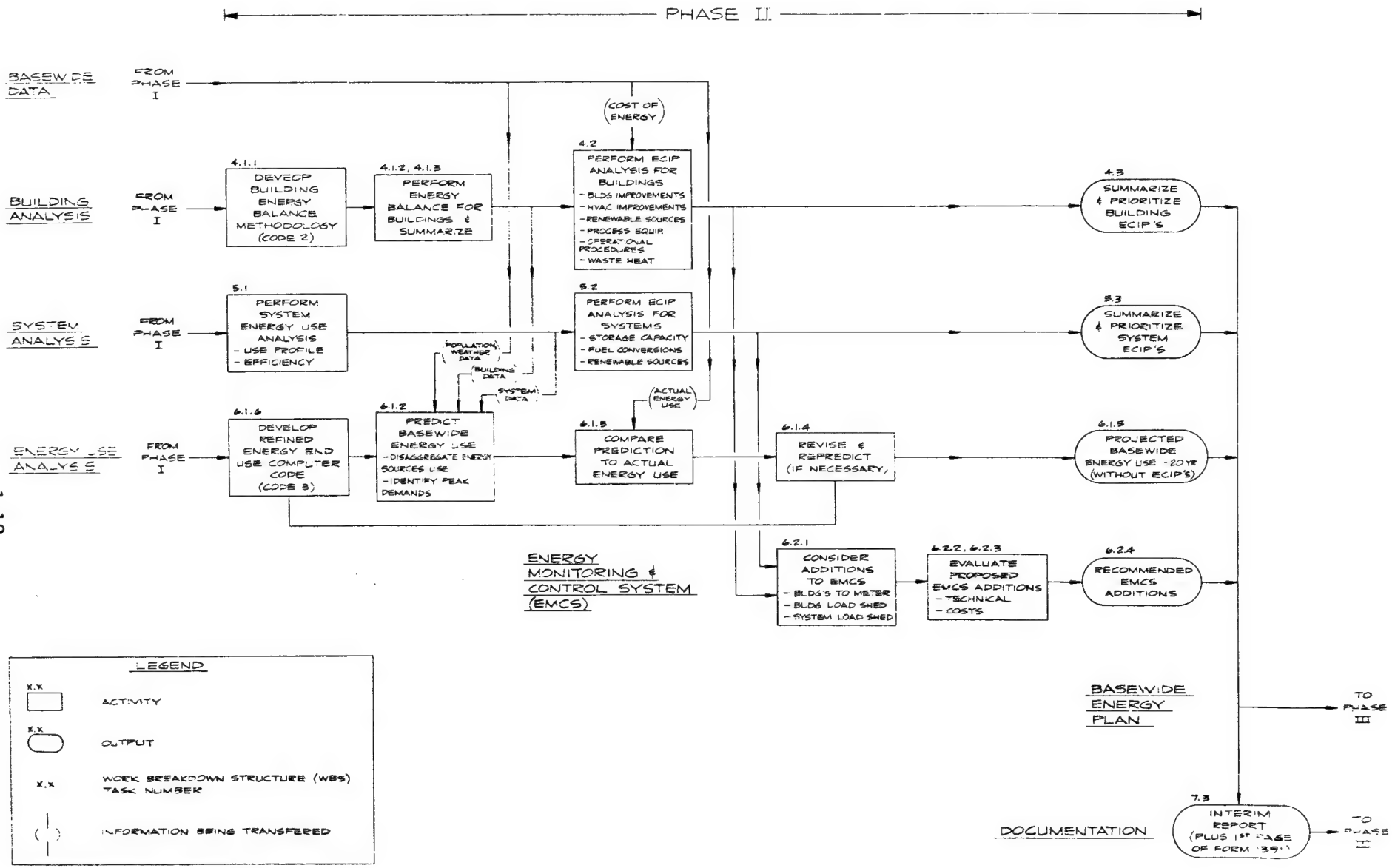

Figure 1-2. Increments A & B -- Phase II Approach

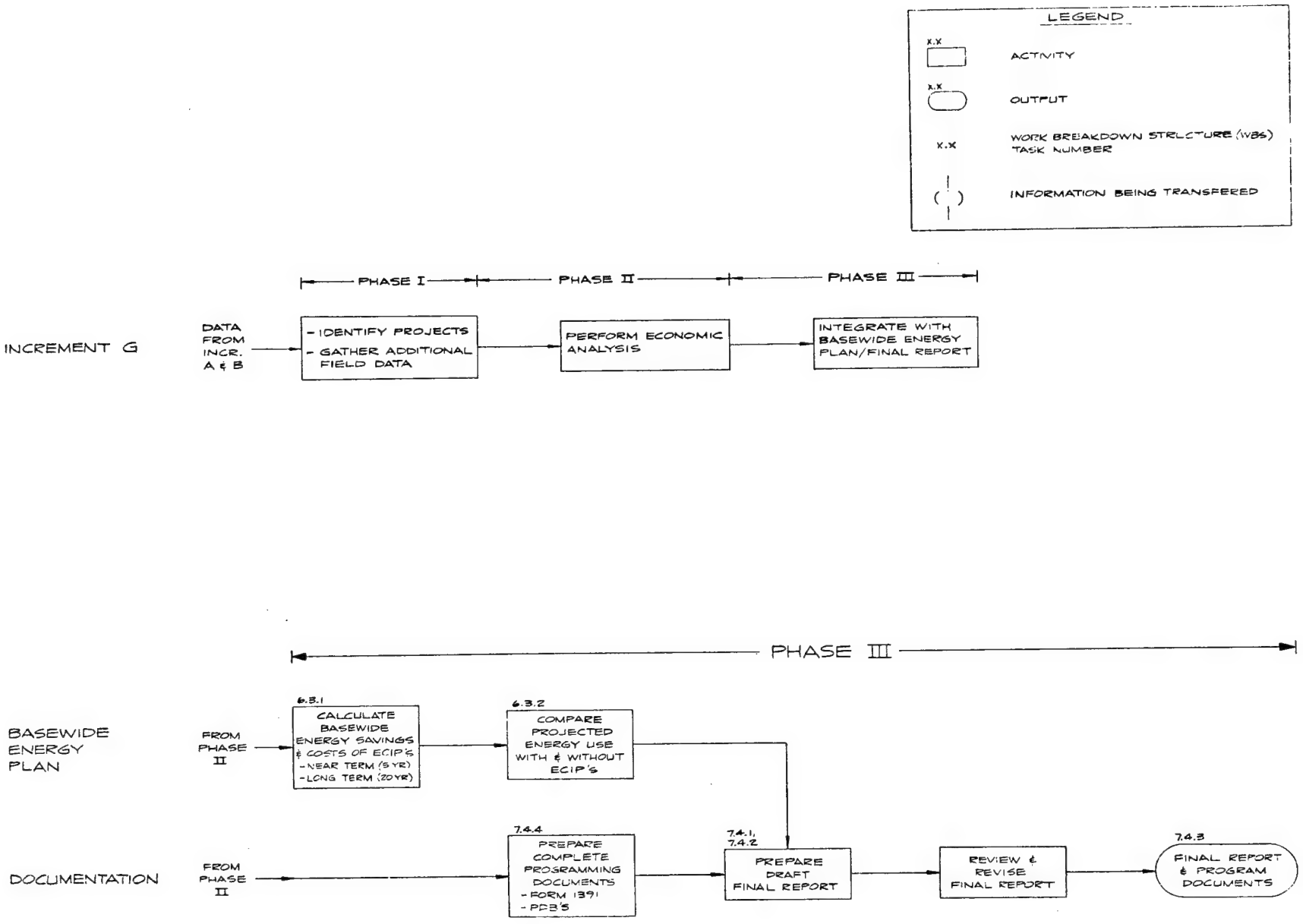

Figure 1-3. Increments A & B -- Phase III Approach

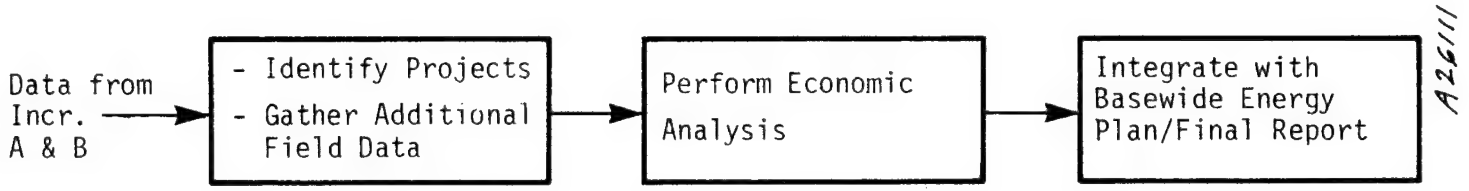

Figure 1-4. Increment G Approach

insulation blankets to homes recently retrofit with attic insulation; nearly 2000 Fort Ord family housing units will be provided with blankets under this program.

1.4.2 Field Survey

1.4.2.1 Detailed Audits

The heart of any energy conservation program is the energy audit. It is the audit that establishes the pattern of energy consumption and thereby provides the information necessary to identify and evaluate conservation opportunities. The audit also uncovers patterns and isolated instances of energy waste. Ideally each building or system using energy should be audited; however, the scope of this effort and the size of the Fort Ord/Presidio complex did not allow this. The lack of detailed information on each building/system was largely offset by a high degree of repetition in building type and function. Therefore, it was possible to do a detailed audit of only 53 individual buildings and still represent approximately 75 percent of the total Fort Ord/Presidio square footage. Buildings using very little energy were excluded from the detailed audit as well as buildings scheduled for demolition prior to FY 83.

A six-page form was developed specifically for this study to record the data gathered from each building during the detailed energy survey. The completed forms are included in Volume IIB, Appendix D for Fort Ord and Volume IIIB, Appendix D for the Presidio. A blank copy of this form is included at the end of this volume. The first sheet was used to record the size and construction materials of the building. The function, population, and hours of usage of the building were also recorded. This information was necessary for the energy balance calculations, as well as the identification of opportunities for building shell insulation.

Page 2 provided an area to sketch a rough diagram of the building. This sketch was useful in identifying the location of energy users in the more complex buildings.

Page 3 was a form for listing the various types, location, and usage of lighting, both interior and exterior. This information was necessary in the development of the energy balance and as a method of identifying areas where more efficient lighting could be used.

Page 4 was used to record pertinent data involving the building heating system. This information was necessary to evaluate the performance of the heating systems and energy-saving modifications.

Page 5 was used to list all of the remaining miscellaneous energy-using devices in the building. This information was necessary to develop the energy balance.

Page 6 was reserved for special comments on energy usage. Typically, instances of energy waste or opportunities for energy-saving modifications were noted on this page.

1.4.2.2 Waste Walk Through

At the conclusion of the detailed audits it was felt that sufficient information to determine the energy use patterns at Fort Ord had been obtained. However, the decision was made to conduct a number of "waste walk throughs" of additional buildings in an effort to uncover additional energy waste and further opportunities for energy conservation applications. These "waste walk throughs" were able to be done much more rapidly than the detailed audits since individual energy uses and building dimensions and characteristics were not noted unless directly applicable to specific conservation action.

Obvious instances of energy waste observed during both the detailed audit and the "waste walk through" were compiled and transmitted to the DFAE Energy Branch each week in the form of a "quick-fix" list. The intent was to call attention to situations where direct action requiring little or no expense would have an immediate energy reduction effect.

1.4.2.3 Supplemental Field Work

A significant amount of additional field work was performed throughout the study period to supplement information gathered during the detailed audit phase. This was necessary in order to obtain sufficient specific data to perform the technical and economic analyses required in the development of ECIP projects. Similarly, although Increment G projects were identified primarily from information gathered during Increments A and B, much more detailed information was required to develop these projects, necessitating further field work.

1.4.3 Disaggregate Energy End Use

1.4.3.1 Energy Use in Buildings

Energy use associated with individual buildings was subdivided into:

- Space heating
- Water heating, cooking, and miscellaneous fuel use
- Lighting
- Miscellaneous electricity use, including cooling

For simplicity, "process" use of steam at the laundry and hospital are included under "miscellaneous fuel use." "Miscellaneous electricity use" includes refrigeration systems at the commissary and cold storage facilities, in addition to all cooling of buildings. Cooling was not listed separately because only three of the buildings audited at Fort Ord and one at Presidio of Monterey are cooled.

A computer program was developed during this study to generate annual heating energy consumption projections for each building audited utilizing data from the detailed audit sheets and other information collected during the field survey. Nonheating fuel energy and electrical energy values were calculated separately as described below and input to the computer program for inclusion in the tabulated summary for each building type. The term "fuel energy" as used in these tabulations includes both fuel oil and natural gas.

Major comments and assumptions pertaining to heating energy calculations are:

1. 3818 yearly degree days (Reference 2: "Facility Design and Planning: Engineering Weather Data," Departments of the Air Force, Army and Navy)
2. R values (listed in Table 1-2)
3. An infiltration heat loss equivalent to an air change of one building volume per hour was assumed for all buildings except the Hays Army Hospital for which the actual ventilation heat load was calculated from the mechanical design drawings.
4. The yearly average heating system efficiency was assumed to be 65 percent.
5. Time controls presented are as found at the time of the field survey; that is, prior to EMCS.

Nonheating uses of fuel include primarily hot water and cooking, as described in Table 1-3. The assumed family housing hot water use of 30 gal/person/day (derived from Reference 3: "Other Homes and Garbage," by J. Leckie, et al.) is 20 percent higher than the norm recommended in the "Family Housing Metering Test" study (Reference 4). An overall water

Table 1-2. Insulation Value of Common Materials

Material	Thickness (inches)	R Value (ft^2-hr-^oF/Btu)
Air Film and Spaces:		
Air space, bounded by ordinary materials	3/4 or more	.91
Air space, bounded by aluminum foil	3/4 or more	2.17
Exterior surface resistance	--	.17
Interior surface resistance	--	.68
Masonry:		
Sand and gravel concrete block	8	1.11
	12	1.28
Lightweight concrete block	8	2.00
	12	2.13
Face brick	4	.44
Concrete cast in place	8	.64
Concrete slab on grade	--	10.00*
Building Materials -- General:		
Wood sheathing or subfloor	3/4	1.00
Fiber board insulating sheathing	3/4	2.10
Plywood	5/8	.79
	1/2	.63
	3/8	.47
Bevel-lapped siding	1/2 x 8	.81
	3/4 x 10	1.05
Vertical tongue and groove board	3/4	1.00
Drop siding	3/4	.94
Asbestos board	1/4	.13
3/8" gypsum lath and 3/8" plaster	3/4	.42
Gypsum board (sheet rock)	3/8	.32
Interior plywood panel	1/4	.31
Acoustic ceiling	3/4	1.88
Building paper	--	.06
Vapor barrier	--	.00
Wood shingles	--	.87
Asphalt shingles	--	.44
Built-up roofing	--	.33
Linoleum	--	.08
Carpet with fiber pad	--	2.08
Hardwood floor	--	.71

Table 1-2. Insulation Value of Common Materials (Continued)

Material	Thickness (inches)	R Value (ft^2-hr-^oF/Btu)
Insulation Materials (mineral wool, glass wool, wood wool):		
Blanket or batts	1	3.70
	3-1/2	11.00
	6	19.00
Loose fill	1	3.33
Rigid foam panels	1-1/2	9.40

*Effective value based on average conditions.

Sources: (1) "Project Retrotech Home Weatherization Charts," DOE/CS-0131, Office of Weatherization Assistance, Washington, D.C., revised July 1979.

(2) ASHRAE Handbook, Fundamentals, 1977.

Table 1-3. Data Used to Determine Hot Water and Cooking Energy Consumption

Type Building	Daily Hot Water Used (gal/person) (@ 140°F)[a]	Annual Cooking Energy Used (mega Btu/person) (if kitchen present)
Family housing	30	3.2
Troop housing	25	2.2
Mess hall	6 @ 180°F	2.2
Admin/training	2.5	--
Clinics	5	--
Theatres	1	--
Hospital	40 (patients) 2.5 (staff)	2.2

[a]Inlet temperature = 60°F

Sources:

(1) P. B. Shepherd, "Performance Evaluation of Point-of-Use Water Heaters," Johns-Manville Sales Corporation, 15 October 1980. Prepared for U.S. Army FESA, Technology Support Division, Fort Belvoir, Virginia.

(2) Energy and Environmental Analysis, Inc., "End Use Energy Consumption Data Base: Series I Tables," Department of Energy, PB-281817, June 1978.

(3) Jim Leckie, et al., Other Homes and Garbage, Sierra Club Books, 1975.

(4) "Family Housing Metering Test," Office of the Deputy Assistant Secretary of Defense (Installations and Housing), March 1, 1980.

heater efficiency of 55 percent (including standby losses) was used, based on information in References 5 ("Performance Evaluation of Point of Use Water Heaters," FESA-TS-2081) and 6 ("Evaluation of Energy Conserving Modifications for Water Heaters," U.S. National Bureau of Standards") Family housing cooking use was also assumed to be 20 percent above the study norm. The other major fuel use is for process steam used at the Fort Ord laundry (building 2068). In this case the approximate yearly consumption was derived from the boiler logs for FY 79. Meter records were also used to determine miscellaneous gas use in the Hays Army Hospital.

To estimate electrical consumption, annual operating hours of various appliances were obtained from conversations with building occupants combined with published material on typical usage, and in some cases, engineering judgement. Typical power consumptions of common appliances are shown in Table 1-4. Additional assumptions include:

1. Average lamp usage:

Family housing -- all lamps	6 hr/day per lamp (see Table 1-5)
Troop housing -- rooms	6 hr/day per lamp
-- halls, baths	12 hr/day per lamp
Outside lights, except family housing	12 hr/day

2. Motors: 60 percent average load factor assumed when load data unavailable. An average efficiency of 85 percent was used for motors 3 hp and larger; 60 percent was used for smaller motors. These values were selected on the basis of Reference 7 ("Classification and Evaluation of Electric Motors and Pumps,"

Table 1-4. Typical Power Consumption of Common Appliances

Appliance	Average Power (watts)	Typical Use (kWh/yr)
Clock	2	24
Coffee maker (automatic)	850	96
Dishwasher	1180	348
Food blender	290	12
Food freezer (standard, 15 ft^3)	350	1056
Food freezer (frostless, 15 ft^3)	440	1524
Iron (hand)	1085	144
Radio	75	84
Radio-phonograph	115	108
Refrigerator (standard, 12 ft^3)	265	852
Refrigerator (frostless, 12 ft^3)	295	948
Refrigerator-freezer (standard, 14 ft^3)	290	1200
Refrigerator-freezer (frostless, 14 ft^3)	435	1572
Television (black & white)	255	360
Television (color)	315	415
Toaster	1130	35
Vacuum cleaner	700	36
Washing machine (automatic)	600	84
Hot plate	1250	8
Coke machine	--	1000
Water cooler	--	500
Small refrigerator	--	500
Small television	--	250
Copier (light use)	--	250
Copier (heavy use)	--	1000
Fluorescent ballast transformer: 15 percent of lamp wattage		

Sources: (1) Craig B. Smith, ed., Efficient Electricity Use, prepared for The Electric Power Research Institute, Pergamon Press, Inc., 1976.
(2) Jim Leckie, et al., Other Homes and Garbage, Sierra Club Books, 1975.

Table 1-5. Family Housing Lighting Assumptions

Inside Lights

1. Heavy use period: 5 to 10 p.m. and 6 to 7 a.m. (6 hours)
   Assume 60 percent of lights on

2. Medium use period: 7 a.m. to 5 p.m. (10 hours)
   Assume 25 percent of lights on

3. Night: 10 p.m. to 6 a.m. (8 hours)
   No lights on

Daily average: $(\frac{6}{24})$ (0.60) + $(\frac{10}{24})$ (0.25) = 25 percent of lights on

This is equivalent to all lights being on 6 hours/day

Exterior Lights

Average darkness period is 12 hours/day; of which people are asleep about 8 hours

1. 50 percent of the units -- lights are on 4 hours/day

2. 25 percent of the units -- lights are on all night (12 hours)

3. 25 percent of the units -- lights are on 2 hours/day

Average: about 6 hours/day

DOE/CS-0147), pages 3-10, 3-21 and 3-40, combined with a deduction of 3 to 5 percent for assumed wear.

3. A source equivalence of 11,600 Btu/kWh was used for conversion of electrical energy consumption data.

1.4.3.2 Energy Use in Systems

Energy use in systems was subdivided into:

- Water and sewage
- Exterior lighting
- Electrical distribution
- Boiler plants

Water and sewage use (primarily electricity for pumping) was computed using production records (when available) or estimates provided by plant personnel for each device, combined with measured or estimated efficiencies. Exterior (street) lighting energy use was computed based on installation street lighting maps and discussions with electrical shop staff. Energy losses associated with electrical distribution are discussed in broad terms; no specific analytical or test data are available for this system, although a study by the Facilities Engineering Support Agency is currently being performed. Boiler energy use, although already included in the building energy category, was analyzed in further detail as a separate system, primarily using data from boiler logs and efficiency tests. Boilers selected for analyses represent approximately 75 percent and 45 percent of the installed boiler capacity at Fort Ord and Presidio of Monterey, respectively.

1.4.4 Energy Conservation Investment Program (ECIP) Projects

Potential ECIP projects were identified through a review process that included:

- Reviewing and evaluating previous or current studies relating to potential ECIP projects. This list included all projects already funded or proposed for funding and those that failed to meet ECIP criteria that were proposed by Fort Ord previous to this study, as well as the sources listed in Table 1-6.
- Identification of areas of waste during detailed building audits and other field work.
- Researching utility bills and segregating the energy use into various components by end use (lighting, heating, etc.) and by end user (family housing, barracks, etc.), to identify where large amounts of energy were being consumed and possibly wasted.
- Discussions with Fort Ord staff members. This included Facilities Engineering employees as well as building occupants.

As a result of this review process, a list of potential projects was developed for evaluation. These were evaluated in accordance with "Energy Conservation Investment Program (ECIP) Guidance," letter DAEN-FEU Department of the Army (Reference 8), AR 415-15, "Military Construction, Army (MCA) Program Development" (Reference 9), AR 415-17, "Cost Estimating for Military Programming" (Reference 10), and AR 415-28 "Department of the Army Facility Classes and Construction Categories" (Reference 11). Criteria included a minimum energy-to-cost ratio (E/C) of 13.0 for FY 1984, minimum benefit-to-cost ratio (B/C) of 1.0 and a total cost of over $100,000.

The evaluation of ECIP's required escalation of energy and construction costs to the program year (FY84). Construction costs were escalated in accordance with "EIRS Bulletin 81-01", dated 9 February 1981

Table 1-6. Reference Sources for Potential ECIP Projects

"Feasibility Study for Energy Monitoring and Control System, Fort Ord, California," prepared for Sacramento District, Corps of Engineers, by Donald Bentley and Associates, May 1977.

"Basis for Design, Control Systems Alterations, Fort Ord, California," prepared for Sacramento District, Corps of Engineers, by Donald Bentley and Associates, 8 May 1978.

"Feasibility Study, Energy Control System, Presidio of Monterey, California," prepared for Sacramento District, Corps of Engineers, by Nack & Sunderland, January 1978.

"Air Emissions Study for Fort Ord, the Presidio of Monterey, and Fort Hunter Liggett," prepared for Sacramento District, Corps of Engineers, by Engineering-Science, Inc., August 1978.

"Solid Waste Study for Fort Ord and the Presidio of Monterey, California," prepared for Sacramento District, Corps of Engineers, by Engineering-Science, Inc., August 14, 1978.

"The Master Plan of Fort Ord, California: Analysis of Existing Facilities/Environmental Assessment Report," prepared for Sacramento District, Corps of Engineers, by Robert G. Muir & Associates, July 1977.

"The Master Plan of Presidio of Monterey, Analysis of Existing Facilities/Environmental Assessment Report," prepared by Sacramento District, Corps of Engineers, by Robert G. Muir & Associates, July 1977.

"Emergency Expansion Capability Plan, Fort Ord, California," prepared for Sacramento District, Corps of Engineers, by Robert G. Muir & Associates, October 1978.

"Reducing Water Pumping During 'On Peak' Periods -- A Peak Management Program," Fort Ord Energy Branch, December 1979.

"Study of Environmental Deficiencies at the Commissary Building 4240, Fort Ord, California," Lee & Associates, January 27, 1981.

"Combustion Efficiency Test Reports, Fort Ord Boilers," prepared by PG&E, October 1980.

(Reference 12). All labor rates and construction estimates were obtained from local firms or construction estimation handbooks. Wage rates obtained from such handbooks were multiplied by a factor of 1.86 to account for overhead and profit based on experience with Northern California billing rates. Fuel escalation rates were obtained from PG&E and found to be in reasonably close agreement with those recommended in "ECIP Guidance" (Reference 8). Unescalated fuel costs were derived from Fort Ord energy bills from October 1980. Section 1 of Volume IIA contains more information on energy cost projections. Project Development Brochures (PDB) were completed in accordance with Technical Manual No. 5-800-3, "Project Development Brochure" (Reference 13).

1.4.5 Maintenance, Repair, and Minor Construction Projects

These projects were identified during Phase III of Increments A and B by reviewing:

- Field data collected during Phases I and II
- Potential ECIP projects which did not meet ECIP criteria
- Suggestions received from installation personnel and others involved in reviewing this study.

Economic analyses were then performed based on ECIP procedures. In most cases supplemental field work was required to obtain sufficiently detailed data for these analyses. The requirements of AR 415-35, "Minor Construction" (Reference 14), DA Pamphlet 420-6, "Facilities Engineering Resources Management System" (Reference 15), and AR 420-10, "Facilities Engineering" (Reference 16), were followed. Fuel costs used for these analyses were based on October 1980 data, the same as those used for ECIP analyses. A review of utility bills indicated very little change in price

between October 1980 and March 1981, and therefore these costs are also valid for March 1981.

Although DD Forms 1391 and other programming documents were not prepared for minor construction projects, sufficient information is presented to allow the installation to easily produce these documents at its option by extracting technical and economic data and updating the economic evaluations. For maintenance and repair projects adequate data is presented so that the installation can prepare work orders or local projects.

SECTION 2

SUMMARY OF RESULTS - FORT ORD

2.1 EXISTING ENERGY CONSUMPTION

2.1.1 Field Survey Conclusions

The most serious energy conservation problems observed during the field survey at Fort Ord included steam leaks, overheating of buildings (due to faulty thermostats or other controls), and poor building insulation. Numerous examples of equipment malfunction were also responsible for substantial energy waste. Other problems include infiltration in temporary buildings, bare steam and hot water pipes, oversized boilers, worn water and sewage pumps, and an inefficient refrigeration system at the commissary. Other specific problems are documented in this report.

On the positive side, the consumer awareness program has been an outstanding success at Fort Ord. Building occupants demonstrated a serious concern for energy conservation and few examples of improper thermostat settings or excessive lighting were seen where occupants had control over these functions. In fact, overheating problems were almost nonexistent where occupants had control, in contrast to "automatically" regulated buildings where many problems were found. Many energy conserving policies are in effect, such as elimination of barrack heating during duty hours, elimination of heating in most high-bay maintenance

buildings, elimination of hot water in administrative buildings, and stringent water-use guidelines. Most large heating systems feature energy saving features such as reset of hot supply water temperature with ambient temperature or damper/economizer controls. Substantial improvements in monitoring and control of heating, especially scheduling and night setback features, will be provided by the Energy Monitoring and Control System (EMCS) currently being installed.

Most heating plants observed were reasonably clean. In particular, maintenance of high-pressure boilers appears to be very good, including water treatment, blowdown procedures, routine adjustments, and records kept. The potential usefulness of these records is diminished, however, by old and inaccurate (or nonexistent) meters and gages.

2.1.2 Historical Energy Use and Costs

Annual energy use from all sources for the past four years at Fort Ord is presented in Figure 2-1 and summarized (with costs) in Table 2-1. Figure 2-2 illustrates the consumption trends from FY75 to FY80 in comparison to the FORSCOM energy reduction goals ("target" lines in Figure 2-2). Population and building square footage trends are shown for reference. It is evident that the reduction per square foot is ahead of target, whereas the absolute reduction is behind target: this is due, of course, to the expansion of building square footage from FY75 to FY80.

2.1.3 Disaggregate Energy End Use

A computer program was developed during this study to calculate annual heating consumption for each building audited and project totals for groups of repetitive buildings. An information summary from this program is presented in Table 2-2. Two indicators of relative energy consumption level are listed: (1) "Percent Total Use," which can be

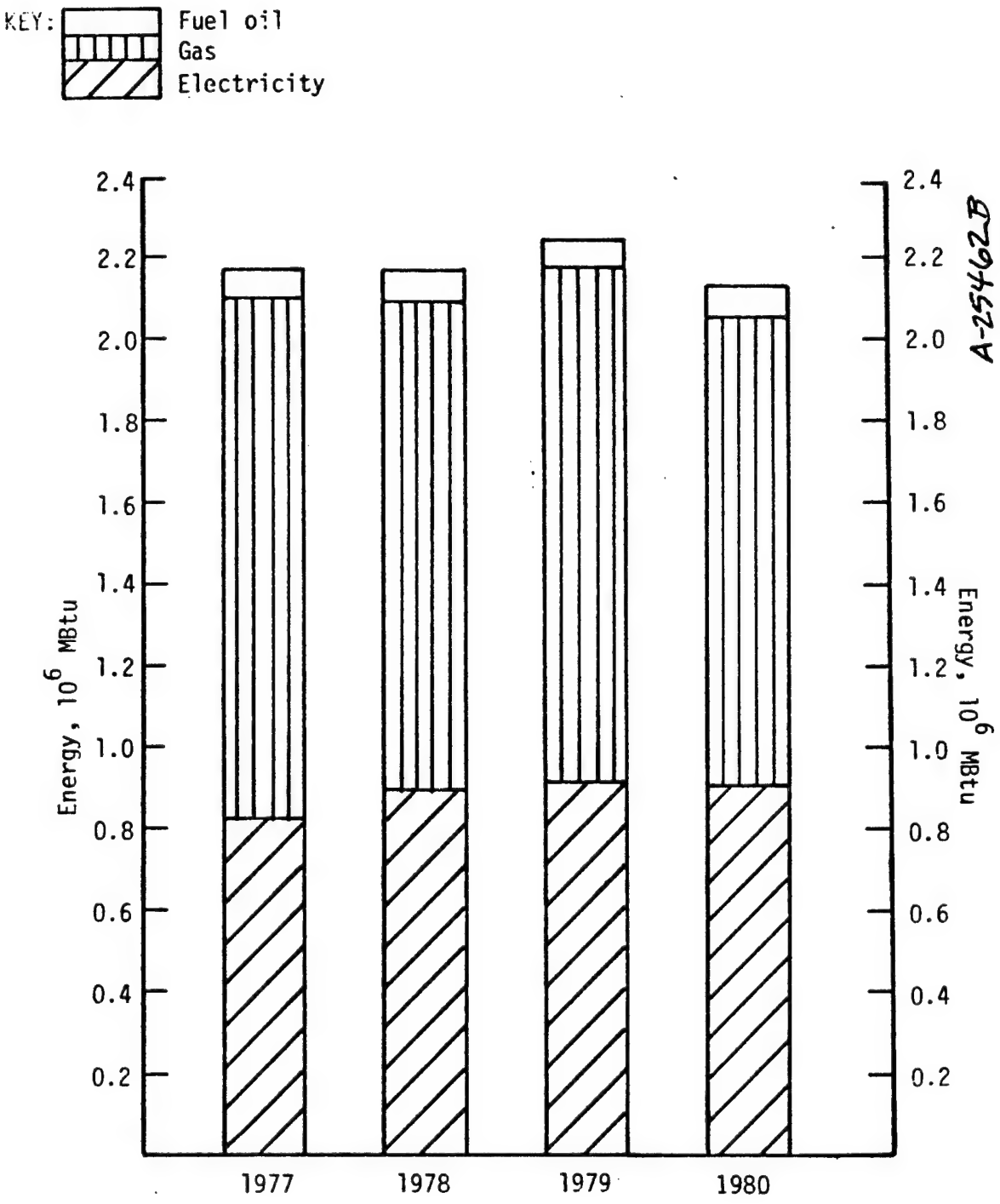

Figure 2-1. Fort Ord Annual Energy Use

Table 2-1. Fort Ord Annual Energy Use and Costs[a]

Year	Electricity		Natural Gas		Fuel Oil		Total	
	Use (MBtu)	Cost ($000)	Use (MBtu)	Cost ($000)	Use MBtu	Cost[b] ($000)	Use MBtu	Cost ($000)
1977	825,968	2,603	1,286,961	2,699	56,849	244	2,169,778	5,546
1978	888,667	2,989	1,204,108	2,699	80,109	458	2,172,884	6,146
1979	918,267	2,535	1,248,471	2,717	77,053	688	2,243,791	5,940
1980	911,355	3,469	1,164,796	4,155	76,499	693	2,152,650	8,317

[a]All energy use units are MBtu and the following conversion factors were used:
1 kWh = 11,600 Btu; 1 Therm = 0.1 MBtu; 1 gal fuel oil = 138,000 Btu.

[b]Accurate cost information was not available for Fort Ord; regional price information was obtained from "Energy User News".

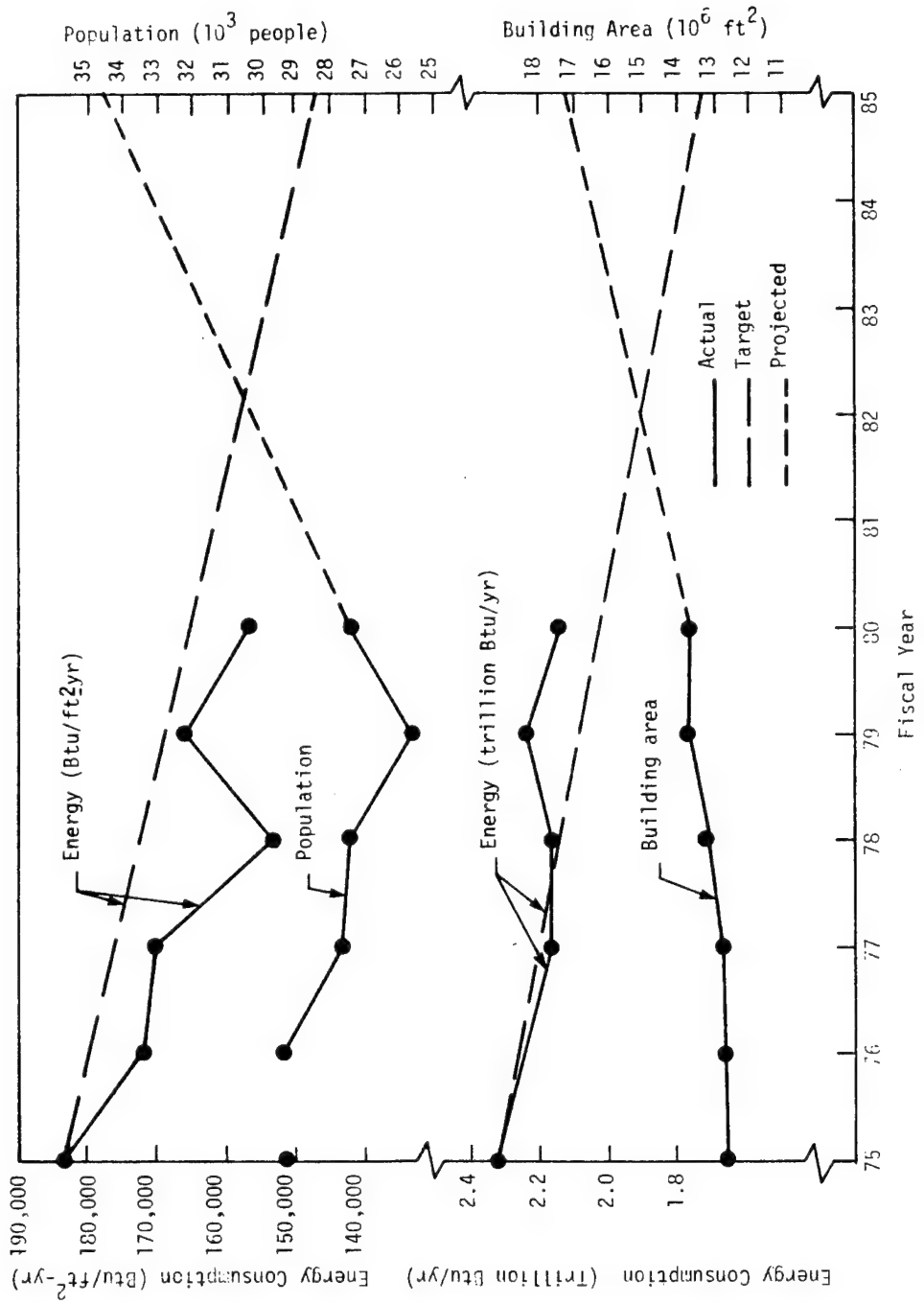

Figure 2-2. Annual Utilities Consumption for Fort Ord

Table 2-2. Information Summary - Energy Use in Buildings

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FORT ORD ENERGY SURVEY
INFORMATION SUMMARY

BLDG NO	TYPE*	GROSS SQUARE FEET REPPESENTED GSF	% TOTAL GSF	PROJECTED ENERGY USE (MEGA BTU / YR) FUEL	ELECT	TOTAL	% TOTAL USE	ENERGY UTILIZATION INDEX (BTU/GSF/YR)
507	A	104366.0	.76	8381.2	14303.2	22684.5	1.04	217354.8
524	B	71007.0	.52	3673.1	4254.9	7928.0	.36	111650.3
1010	C	219834.0	1.60	7030.6	8017.9	15048.5	.69	68454.1
1426	D	150696.0	1.10	8893.8	7186.2	16080.0	.74	106704.8
1672		18346.0	.13	6.0	846.8	852.8	.04	46484.2
1674		18346.0	.13	32.0	1867.6	1899.6	.09	103543.0
1715	E-1	660800.0	4.82	21672.4	22248.8	43921.2	2.01	66466.7
2060		15542.0	.11	5.0	15938.4	15943.4	.73	1025826.8
2061		10700.0	.08	2.0	498.8	500.8	.02	46803.7
2062		5609.0	.04	.0	.0	.0	.00	.0
2063		31223.0	.23	3.0	1484.8	1487.8	.07	47650.8
2064		11218.0	.08	365.4	533.6	899.0	.04	80139.9
2065		18876.0	.14	11.0	870.0	881.0	.04	46673.0
2068		49140.0	.36	20400.0	6948.4	27348.4	1.25	556540.5
2075		51882.0	.38	5144.1	2888.4	8032.5	.37	154822.5
2111	F	185504.0	1.35	8533.3	3253.8	11787.1	.54	63541.1
2216	E-2	660800.0	4.82	.0	.0	.0	.00	.0
2237		24937.0	.18	4982.0	904.8	5886.8	.27	236066.6
2242		20976.0	.15	677.1	707.9	1384.7	.06	66012.0
2248		74034.0	.54	963.0	1693.6	2656.6	.12	35883.5
2252		20976.0	.15	2651.7	2726.0	5377.7	.25	256375.4
2371	G	251484.0	1.83	10842.0	8463.4	19305.3	.88	76765.6
2426		14744.0	.11	5.0	1635.6	1640.6	.08	111272.4
2722		35783.0	.26	1927.9	2204.0	4131.9	.19	115470.2
2726		12000.0	.09	1148.4	1241.2	2389.6	.11	199136.0
2798		37945.0	.28	2289.3	1925.6	4214.9	.19	111079.7
3623	H	224390.0	1.64	25023.3	13804.0	38827.3	1.78	173035.1
3640	I	58044.0	.42	1006.7	4454.4	5461.1	.25	94085.5
3895		20180.0	.15	1213.3	2378.0	3591.3	.16	177965.0
4230		15908.0	.12	524.2	1078.8	1603.0	.07	100769.3
4235		72709.0	.53	4266.0	15532.4	19798.4	.91	272297.0
4240		80590.0	.59	1095.0	35855.6	36950.6	1.69	458501.0
4260		35612.0	.26	4081.2	6496.0	10577.2	.48	297011.5
4275		14400.0	.11	1456.5	3050.8	4507.3	.21	313009.8
4280		24670.0	.18	3492.4	556.8	4049.2	.19	164132.8
4361	J	63582.0	.46	5684.2	6873.1	12557.3	.58	197497.7
4366	K	42048.0	.31	3478.6	3917.7	7396.4	.34	175902.9
4368		24192.0	.18	2933.4	6449.6	9383.0	.43	387855.1
4385		366589.0	2.67	69552.8	83125.6	152678.4	6.99	416484.0
4386	L	38022.0	.28	4341.8	2157.9	6749.4	.31	177514.0
4399		15524.0	.11	565.7	5138.8	5704.5	.26	367465.1
4434	M-1	649600.0	4.74	50574.4	18535.8	69110.2	3.16	106388.8
4452	N	405870.0	2.96	22497.3	16936.0	39433.3	1.81	97157.5
4453	O	45596.0	.33	12209.5	9604.8	21914.3	1.00	478424.9

Table 2-2. Concluded

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FORT ORD ENERGY SURVEY
INFORMATION SUMMARY

BLDG NO	TYPE*	GROSS SQUARE FEET REPRESENTED GSF	% TOTAL GSF	PROJECTED ENERGY USE (MEGA BTU / YR) FUEL	ELECT	TOTAL	% TOTAL USE	ENERGY UTILIZATION INDEX (BTU/GSF/YR)
4480		20457.0	.15	2816.8	1972.0	4788.8	.22	234091.8
4592	M-2	649600.0	4.74	53402.7	31881.6	85284.3	3.91	131287.4
4600		31770.0	.23	4098.8	3340.8	7439.6	.34	234170.4
4789		14481.0	.11	1407.6	1334.0	2741.6	.13	189322.6
4953		55487.0	.40	5474.8	1299.2	6774.0	.31	122083.0
6081	P	672200.0	4.90	46883.3	47956.6	94839.9	4.34	141088.7
7135	Q	1189149.0	8.67	264842.2	60066.9	324909.1	14.88	273228.2
7390	R	2942494.0	21.46	304881.1	168084.6	472965.7	21.66	160756.3
8447	S	366077.0	2.67	40559.8	25745.9	66305.7	3.04	181119.7
TOTAL		10916009.0	79.6	1048252.9	690268.8	1738521.6	79.6	159263.5

*Applies to repetitive buildings only. Letters correspond to letters marked in right-hand margin of Installation Building List (Appendix A). Family housing letter types are not marked in Appendix A, but are defined as follows:

Type	Building Number
P	6006 - 6129
Q	7000 - 7249
	7900 - 8266
R	6300 - 6934
	7300 - 7842
	8500 - 8766
S	8401 - 8473

compared with "Percent Total GSF" (gross square feet) ("total" refers to the installation total); and (2) "Energy Utilization Index" (EUI), which gives the ratio of annual consumed Btu's to gross square feet for the building type represented. These figures provide a detailed picture of where energy is being consumed at Fort Ord and the relative energy intensity levels of various building types. Table 2-3 contains a ranking of buildings by EUI and Table 2-4 summarizes average EUI levels for several common building types. The highest values are for special use buildings, such as mess halls, buildings with refrigeration systems, laundry, and hospital, with the Officers' and NCO Clubs also at high levels. Family housing (comprising the largest single energy use type) is somewhat lower, but still fairly high, due primarily to poor insulation. Troop housing is fairly low, but this is attributable mainly to low occupancy levels in some large barrack complexes, rather than efficient energy use. Administration and maintenance buildings have the lowest EUI levels since most of these are heated only during duty hours and have fairly low lighting levels.

In Table 2-5, computed energy consumption is subdivided into four major categories for several representative buildings and for the installation as a whole. Computed costs per gross square foot in 1980 for the four categories above are presented in Table 2-6.

Table 2-7 presents a summary of annual energy consumption and cost data for the Fort Ord water and sewage systems; Table 2-8 presents consumption and costs for the exterior lighting system.

A summary of computed disaggregate energy end use components at Fort Ord is presented in Table 2-9. Buildings consume over 96 percent of

Table 2-3. Ranking of Buildings by Energy Utilization Index

Building Number	Description	EUI (10^3Btu/gross sq ft/yr)	% of Installation Energy Use
2060	Cold Storage	1,026	0.73
2068	Laundry	557	1.25
*4453	Mess Hall	478	1.25
4240	Commissary	459	1.69
*4385	Hospital	416	6.99
*4368	Officers Club	388	0.68
4399	Dental Clinic	367	0.26
*4275	Library	313	0.21
*4260	NCO Club	297	0.48
7135	Family Housing	273	14.88
*4235	PX	272	0.91
2252	Craft Shop	256	0.25
2237	Swimming Pool	236	0.27
*4480	Gym	234	0.22
*4600	Service Club	234	0.34
507	Hangar	217	1.04
2726	Maintenance	199	0.11
*4361	BOQ	197	0.58
*4789	Theater	189	0.13
8447	Family Housing	181	3.04
*3895	Bowling Center	178	0.16
*4386	Troop Housing	178	0.31
*4366	BOQ	176	0.34
*3623	Troop Housing	173	1.78
*4280	Chapel	164	0.19
7390	Family Housing	161	21.66
*2075	Community Facility	155	0.37
6081	Family Housing	141	4.34

*Indicates buildings to be on EMCS

Table 2-3. Concluded

Building Number	Description	EUI (10^3Btu/gross sq ft/yr)	% of Installation Energy Use
*4592	Troop Housing	131	3.91
4953	Stockade	122	0.31
2722	Maintenance	115	0.19
524	Hangar	112	0.36
*2798	Administration	111	0.19
2426	Maintenance	111	0.08
1426	Administration	107	0.74
*4434	Troop Housing	106	3.16
1674	Maintenance	104	0.09
*4230	Theater	101	0.07
*4452	Troop Housing	97	1.81
*3640	Administration	94	0.25
2064	Clothing Issue	80	0.04
2371	Administration	77	0.88
*1010	Administration	68	0.69
*1713	Administration	66	2.01
2111	Administration	64	0.54
2242	Auto Shop	60	0.06
2063	Storage	48	0.07
2061	Cold Storage	47	0.02
2065	Storage	47	0.04
1672	Maintenance	46	0.04
2248	Fieldhouse	36	0.12
2223	Vacant	0	0
2062	Storage	0	0

*Indicates buildings to be on EMCS

Table 2-4. Energy Utilization Index by Building Type

Type Building	Average Energy Utilization Index (10^3 Btu/gross sq ft/yr)	Approximate Percentage of Installation Energy Use
Family Housing	185	44
Troop Housing	123	11*
Administration	74	5
Maintenance	110	5*
Mess Halls	478	1*
Clubs (NCO, etc.)	300	1
Installation Average	159	

*Based on field survey buildings. Actual total is higher.

Table 2-5. Computed Energy Use in Major Categories for Selected Buildings

Building Number	Function	Projected Annual Energy Use (MBtu)				
		Heat	Other Fuel	Lighting	Other Elect.	Building Total
507	Hangar	5,076	137	7,227	1,670	14,110
1010	Administration	226	34	219	78	557
1426	Administration	395	28	335	7	766
1713	Administration	100	55	150	9	314
2111	Administration	45	1	15	2	63
2371	Administration	92	3	46	28	169
3623	Troop Housing	769	1,733	881	499	3,883
4434	Troop Housing	2,245	920	708	452	4,325
4452	Troop Housing	1,500	750	800	894	3,943
4453	Mess Hall	1,511	1,541	744	1,651	5,454
4592	Troop Housing	2,245	1,097	1,554	441	5,337
4235	PX	4,149	117	10,080	5,452	19,798
4240	Commissary	--	1,095	9,988	25,698	36,951
4385	Hospital	52,668	16,885	18,432	64,694	152,678
2722	Maintenance	1,917	11	1,171	1,033	4,132
2726	Maintenance	1,146	2	534	707	2,390
6087	Family Housing	187	110	198	106	601
7135	Family Housing	468	110	61	70	709
7390	Family Housing	212	110	108	70	500
8447	Family Housing	341	220	240	116	917
Projected Installation Totals		922,000 (42%)	395,000 (18%)	442,000 (20%)	425,000 (20%)	2,184,000 (100%)

Table 2-6. Estimated Annual Costs per Gross Square Foot (GSF) for Various Energy Use Categories in 1980

Category	Energy 10^9 Btu	MBtu per GSF	Cost per MBtu* ($)	Cost per GSF ($)
Heating	904	0.0658	4.10	0.270
Other fuel	389	0.0283	4.10	0.116
Lighting	430	0.0313	4.48	0.140
Electricity	430	0.0313	4.48	0.140
Total	2,153	0.0157	4.24	0.666

*Based on October 1980 prices as follows:
Fuel: 94.2 percent natural gas @ $3.80/MBtu (installation average)
5.8 percent fuel oil @ $9.06/MBtu
Electricity: 5.2¢/kWh = $4.48/MBtu

Table 2-7. Estimated Annual Electricity Use -- Water and Sewage Systems

	Water Pumps	Sewage		Total
		Pumps[c]	Misc.[d]	
Million kWh[a]	3.98	0.74	0.37	5.09
Equivalent MBtu[b]	46,200	8,570	4,290	59,100
Percent installation electricity use	5.1 %	1.4%		6,5%
1980 cost at 5.6¢/kWh	$222,000	$62,000		$284,000
Million gallons produced or treated[a]	1,730	784		--
Btu per gallon	26.7[e]	16.4		43.1[f]
1980 cost per million gallons	$128[e]	$79		$207[f]

[a]Based on 1979 records
[b]1 kWh = 11,600 Btu
[c]Lift pumps and main recirculation pumps
[d]Main Garrison treatment plant equipment excluding main recirculation pumps
[e]Energy to supply outdoor water
[f]Energy to supply indoor water and handle resulting sewage

Table 2-8. Exterior Lighting System Energy Use

Lighting Type	Wattage/ Lamp	Number of Lamps	Assumed Operation Time (hr/yr)	Total Consumption (kWh/yr)
Incandescent	189	1,230	3,650	848,500
Mercury Vapor	400	670	3,650	978,200
Mercury Vapor	250	290	3,650	264,600
High Pressure Sodium	250	66	3,650	60,200
Total kWh				2,151,500
Total Cost (1980)				$122,200

Table 2-9. Summary of Fort Ord Disaggregate Energy End Use

Category	Annual Energy Use (10^9 Btu)			
	Fuel	Electricity*	Total	% Installation Use
Buildings				
Heating	922		922	40.7
Other fuel	395		395	17.4
Lighting		442	442	19.5
Other electricity		425	425	18.7
Buildings -- total	1,317	867	2,184	96.3
Water and sewage		59	59	2.6
Exterior lighting		25	25	1.1
Total projected	1,317	951	2,268	100
Actual use 1980	1,242	911	2,153	--

*Using 11,600 kWh/Btu

the total, with water, sewage, and exterior lighting accounting for the remainder. Actual 1980 energy use is shown for comparison.

2.2 ENERGY PLAN

2.2.1 ECIP Projects

ECIP projects developed during this study are discussed briefly here, in order of descending E/C ratio. Numerical data are given in Table 2-10.

1. Install waterflow restrictors (non-family housing) -- These devices reduce flow rate substantially resulting in very large savings in hot water usage as well as electricity for pumping water.
2. Install waterflow restrictors (family housing) -- Same as above.
3. Insulate family housing hot water tanks -- Most Fort Ord family housing units are to receive tank insulation blankets from the utility as a result of having ceiling insulation installed. This project will cover the remaining units.
4. Install atmospheric desuperheating/subcooling coil (Commissary) -- This is a standard energy-saving feature on all new systems of this type and can be retrofit on existing systems.
5. Install microprocessor-based energy controller (Commissary) -- This device prevents unloaded operation of refrigeration compressors.
6. Convert to infrared and small convective unit heaters -- In some cases, small portions of buildings where workers spend most of their time may be heated rather than heating the entire buildings.

7. Insulate bare pipes -- Many buildings were found to have uninsulated steam, condensate, and hot water pipes.
8. Convert to island-type display case with satellite ice cream system (Commissary) -- Existing open multideck display cases for frozen food and ice cream can be replaced by "island" style cases which use far less energy. A separate or "satellite" booster compressor can be installed; currently the frozen food cases must all operate at the lower suction pressure of the ice cream cases since they are all on the same system.
9. Install foam caulking in temporary buildings -- This product is sprayed into cracks and holes where it expands to form a tight seal.
10. Insulate laundry pipes, presses, and dryers -- This project is necessary to reduce heat losses from steam equipment and piping which is currently either bare or underinsulated.
11. Expand EMCS -- This project is necessary to provide scheduling of heating in the office areas of 12 tactical equipment shops and 5 hangars which are currently heated 24 hours per day.
12. Convert incandescent interior lighting to fluorescent -- This has already been accomplished in most buildings but a number of exceptions were found during the field survey.
13. Install swimming pool solar heating system -- Collector panels will be situated on the roof of the indoor pool to provide year-round heating of pool water.
14. Convert incandescent street lights to high pressure sodium (family housing) -- Substantial wattage reduction can be achieved while lumen levels will increase with this project.

15. Convert incandescent street lights to high pressure sodium (non-family housing) -- Same as above.

Table 2-10 contains a summary of information for all previous and proposed Fort Ord ECIP projects and shows how they help meet the FORSCOM goals. Projects developed during this study are for FY84 and are ranked by energy-to-cost (E/C) ratio. The total computed annual energy savings from these projects is 104,861 MBtu (annual cost savings at projected FY84 prices: $791,000). Total construction cost is $1.54 million.

The column in Table 2-10 entitled "Percent Reduction per Ft^2" indicates the contribution of each project to this goal, while the column entitled "Percent Goal Remaining" indicates how much of the 20 percent goal remains to be accomplished after implementation of each project. While there are few very large-scale projects listed in Table 2-10, it is evident that the 20 percent reduction per square foot can easily be achieved by 1985 exclusively through ECIP projects. The second goal of a 25 percent reduction in the absolute level of energy consumption is not likely to be realized at Fort Ord because of the continuing expansion of both population and building square footage. A 6 percent energy reduction occurred from 1975 to 1985 in spite of a 9 percent growth in square footage. Based on reductions due to proposed ECIP projects only, the total 1985 consumption is projected to be 2.44 trillion Btu/yr, a growth of 6 percent from the 1975 level of 2.30 trillion Btu/yr. The square footage will have grown by 38 percent during this same period, however.

It is well to note that a per-square-foot energy reduction of 14.2 percent occurred between 1975 and 1980, with only 2.7 percent attributable to ECIP projects. Thus, a reduction of 11.5 percent has

Table 2-10. ECIP Summary

FY	Building Area (10^6 sq ft)	ECIP Project or Status	Cost K	E/C	B/C	Payback (yr)	Energy Reduction			Energy Consumption			Percent Energy Reduction	Percent Goal Remaining
							MBtu/Yr	$K/yr	Btu ft^2-yr	10^{12}Btu yr	$K/yr	Btu ft^2-yr		
75	12.59	1975 Status	--	--	--	--	--	--	--	2.31	3,158	183,000	0	20
78	13.09	Insulate Ceilings in Family Housing	1,047	61.0	2.2	--	63,880	179.0	4,880	--	--	178,120	2.67	17.33
80	13.74	1980 Status	--	--	--	--	--	--	--	2.16	8,317	157,000	14.21[a]	5.79
81	14.15	Replace Thermostats (Family Housing)	300	64.0	2.94	--	19,200	67.0	1,357			155,643	0.74	5.05
81	14.15	Energy Monitoring and Control System (EMCS)	2,189	44.0	1.5	--	115,300	296.0	8,148			147,495	4.45	0.60
81	14.15	Replace Pilot Lights	406	30.7	1.12	--	13,400	53.5	947			146,548	0.52	0.08
84	17.14	Install Waterflow Restrictors (Non-family Housing)	23	1,289	121.9	0.1	30,396	231.6	1,773			144,775	0.97	0
84	17.14	Install Waterflow Restrictors (Family Housing)	67	561	40.0	0.3	37,766	218.3	2,203			142,572	1.20	0
84	17.14	Insulate Family Housing Hot Water Tanks	10	102	4.98	1.7	1,008	5.7	59			142,513	0.30	0
84	17.14	Install Atmospheric Desuperheating/ Subcooling Coil	8	64.9	4.31	1.9	508	4.1	30			142,483	0.02	0
84	17.14	Install Micro-processor-Based Energy Controller	30	49.2	3.26	2.5	1,463	11.7	85			142,398	0.05	0

[a]Cumulative through FY80 -- includes non-ECIP reductions
[b]Based on reductions from ECIP projects only
[c]Estimate based on 14% annual growth in unit energy costs from FY80-85
[d]Cumulative through FY85 based on ECIP projects only

Table 2-10 Concluded

FY	Building Area (10^6 sq ft)	ECIP Project or Status	Cost K	E/C	B/C	Payback (yr)	Energy Reduction			Energy Consumption			Percent Energy Reduction	Percent Goal Remaining
							MBtu/Yr	$K/yr	Btu ft^2-yr	10^{12}Btu yr	$K/yr	Btu ft^2-yr		
84	17.14	Convert to Infrared and Small Convective Unit Heaters	114	47.7	3.15	2.8	5,456	41.5	318			142,080	0.05	0
84	17.14	Insulate Bare Pipes	87	36.0	2.37	3.7	3,112	23.7	182			141,898	0.10	0
84	17.14	Convert to Island Cases with Satellite Ice Cream System	113	31.7	2.10	3.9	3,567	28.5	208			141,690	0.11	0
84	17.14	Install Form Caulking in Temporary Buildings	102	26.3	1.73	5.0	2,680	20.4	156			141,534	0.09	0
84	17.14	Insulate Laundry Pipes, Presses and Dryers	46	26.1	1.72	5.0	1,207	9.2	70			141,464	0.04	0
84	17.14	Expand EMCS	371	25.2	3.85	3.5	9,341	106.5	545			140,919	0.30	0
84	17.14	Convert Incandescent Interior Lighting to Fluorescent	103	15.4	1.49	7.7	1,587	13.4	93			140,826	0.05	0
84	17.14	Install Swimming Pool Solar Heating System	143	15.2	1.44	8.7	2,191	16.6	128			140,698	0.07	0
84	17.14	Convert Incandescent Street Lights to HPS (Non-family Housing)	102	14.3	1.92	5.2	1,444	19.5	84			140,614	0.05	0
84	17.14	Convert Incandescent Street Lights to HPS (Family Housing)	220	14.3	1.89	5.3	3,135	41.3	183			140,431	0.10	0
85	17.40	1985 Status[b]	--	--	--	--	--	--	--	2.44	18,090[c]	140,431	23.27[d]	0
		Summary of 1984 ECIP Projects	1,539	--	--	--	104,861	791.0	6,117				3.35	

[a]Cumulative through FY80 -- includes non-ECIP reductions
[b]Based on reductions from ECIP projects only
[c]Estimate based on 14% annual growth in unit energy costs from FY80-85
[d]Cumulative through FY85 based on ECIP projects only

occurred as a result of factors other than ECIP projects. These factors are primarily operational in nature and include the following:

- An aggressive program of energy conservation by the DFAE Energy Branch, especially the "roving inspector" system.
- Construction of new, energy efficient buildings.
- Demolition of old wooden buildings or conversion of these to functions requiring fewer hours of heating.

All of these factors will continue to provide energy consumption reductions through 1985. The roving inspector system has been expanded, and a regular communication structure with unit commanders has been developed which is expected to improve accountability for energy conservation. As more new buildings are under construction or planned, usage of older buildings will continue to be reduced. Thus the 1985 energy consumption is expected to be significantly lower than shown in Table 2-10.

2.2.2 Maintenance, Repair, and Minor Construction Projects

Tables 2-11 and 2-12 present information on projects developed for buildings and systems, respectively.

Projects have been developed for 1981 and therefore are based on current (unescalated) costs. Projects are ranked by B/C ratio; those with B/C below 1.0 are listed but their energy savings are not included in the totals. The total annual energy savings for all projects with B/C greater than 1.0 are 29,731 MBtu (cost savings: $142,000). This is equivalent to 1.1 percent of the 1975 baseline. Cost of implementing these projects is $362,000. In addition there are two potential family housing insulation projects with adverse B/C ratios but large energy savings. Implementation of these projects, while not cost effective at current energy prices,

Table 2-11. Maintenance, Repair, and Minor Construction Projects (Buildings)

Project	Cost ($K)	Energy Savings (MBtu/yr)	Energy Cost Savings ($000/yr)	B/C	E/C (MBtu/$000)	Manhours
A. Maintenance and Repair						
1. Replace electric motors	73	997	4.9	0.79	13.7	73
B. Minor Construction						
2. Insulate hot water tanks	0.7	143	0.6	8.02	206	10
3. Convert mess hall from electric to gas applicances	22.5	3,808	20.9	6.91	176	120
4. Convert to thermostatic radiator valves and insulate tanks	6.6	695	3.1	4.10	105	5
5. Install additional light switches	2.8	192	0.9	3.87	68.2	51
6. Install waste heat recovery units in mess halls	36.5	896	4.0	2.09	24.6	336
7. Weatherstrip windows	53.1	1,592	7.2	1.16	29.9	1,157
8. Replace louvered windows with sliding windows	55.1	1,129	3.8	1.08	20.5	533
9. Insulate walls in family housing	2,599	42,824	142.6	0.87	16.5	45,184
10. Insulate roofs and replace roofing in family housing	4,172	66,949	222.9	0.85	16.0	32,858
Totals (for projects with B/C 1.0 only)	177.3	8,455	40.5			

Table 2-12. Maintenance, Repair, and Minor Construction Projects (Systems)

Project	Cost ($K)	Energy Savings (MBtu/yr)	Energy Cost Savings ($000/yr)	B/C	E/C (MBtu/$000)	Manhours
A. Maintenance & Repair						
1. Adjust boiler controls	1.9	5,923	26.7	25.1	3,001	32
2. Repair pumps	53.3	11,002	53.9	8.35	206.3	715
B. Minor Construction						
3. Install boiler air preheat duct	5.1	230	1.0	2.49	44.7	18
4. Convert mercury vapor lights to high pressure sodium	70.2	2,540	12.4	2.1	36.2	
5. Install boiler sequence programmers	54.0	1,581	7.1	1.63	29.3	720
Totals (for projects with B/C 1.0 only)	184.5	21,276	101.1			

would result in a total annual savings of 109,773 MBtu, or 7758 Btu/ft^2: this is over 4 percent of the 1975 baseline. (The roof insulation project is cost-effective if performed in conjunction with scheduled reroofing and the cost of the reroofing is not included.)

Several of the minor construction projects listed in Tables 2-11 and 2-12 satisfy the minimum E/C and B/C requirements for 1984 ECIP funding, although none meet the $100,000 minimum cost when considered alone. It must also be remembered that the E/C ratios for these projects are for 1981; 1984 values would be lower due to construction cost escalation.

2.2.3 Additional Recommendations

Recommendations other than ECIP, maintenance, repair, and minor construction projects but important to the installation energy reduction plan are discussed in this subsection.

2.2.3.1 Load Shedding

Reductions of electrical demand peaks do not ordinarily involve energy savings but can reduce demand charges from the utility. Currently a peak load shedding program involving the water system pumps is being implemented at Fort Ord. Very few additional opportunities exist because of the decentralized character of energy use. The only possible further opportunity identified during this study involves the refrigeration compressors at the cold storage plant (building 2060). A load shedding project at this plant needs to be implemented with great care to avoid disrupting of proper system functioning. Furthermore, quantifying the net potential demand reduction is difficult. This project is not strongly recommended.

2.2.3.2 Metering of Individual Buildings

Most buildings at Fort Ord are not individually metered. Metering allows precise tracking of energy use and improved accountability. Installation of individual gas and/or electrical meters is recommended for mess halls and other buildings with significant energy use of a special nature which cannot be monitored by EMCS or other existing means. Meters for major boiler rooms are also recommended to permit accurate evaluation and optimization of boiler and steam distribution system operations. Specific recommendations are contained in Table 2-13.

2.2.3.3 Waste Fuels

Two onsite-generated wastes were considered in this study: solid waste and waste motor oil. Untreated solid waste has the potential to meet nearly 10 percent of Fort Ord's fuel requirements but would require the installation of new boilers capable of firing a solid fuel. Pyrolysis of solid waste could supply over 5 percent of Fort Ord's fuel needs, but pyrolysis systems are still in the development stage. Combustion of waste oil requires an expensive pretreatment process which would not be cost effective at the present throughput rates.

2.2.3.4 Future Fuel Choices

At present Fort Ord relies on natural gas for over 95 percent of its nonelectrical fuel needs and distillate fuel oils for the remainder. Other options that could be considered for the future include coal, biomass, refuse derived fuel, solar, wind, and advanced conversion techniques such as tidal power. Although it is feasible that some of the above can provide small percentages of Fort Ord's future fuel needs, economic considerations dictate that the majority of the energy requirements must be supplied by natural gas. Current life cycle costs for this fuel are very low compared

Table 2-13. Recommended Meter Installations

Building Number	Description	Quantity	Type	Size
2060	Cold storage	1	Electricity	480/277V, 600A
2069	Laundry	2	Boiler package[a]	20.5 MBtu/hr boiler
3641	Mess hall	1 1 1	Electricity Natural gas[b] Oil flow (boiler)	480/277V, 600A 2 in. (8,000 cfh) 1.0 gpm
4260	NCO open mess	1 1	Electricity Natural gas	120/208V, 400A 2 in. (8,000 cfh)
4368	Officers' open mess	1	Electricity[c]	120/208V, 400A
4385	Hospital	1 3 1 2	Electricity Electricity Natural gas Boiler package[a]	480/277V, 1,200A 480/277V, 600A 3 in. (8,000 cfh) 28.6 MBtu/hr boiler
4600	Service club	1 1	Electricity Natural gas	120/208V, 400A 2 in. (8,000 cfh)
4453 4455 4468 4470	Mess halls	1 ea. 1 ea.	Electricity[d] Natural gas	120/208V, 400A 2 in. (8,000 cfh)

[a]Boiler package shall consist of solid-state recording devices for fuel flow, steam flow, stack temperature, stack CO_2, and draft.
[b]Only if mess hall converted to gas.
[c]Gas meter existing.
[d]Mechanical difficulty may be encountered in meter installation -- contact DFAE Electrical Branch.

Table 2-13. Concluded

Building Number	Description	Quantity	Type	Size
4446 4556 4562 4568 4580 4584 4592 4596 4782 4786 4794 4798	Barracks (mess hall section only)	1 ea. 1 ea.	Electricity Natural gas	120/208V, 400A 2 in. (8,000 cfh)
4430 4440 4552 4562 4580 4590 4782 4792	Barracks (boiler room only)	1 ea. 1 ea.	Natural gas Boiler feedwater	2 in. (8,000 cfh) 200 gpm

to all other alternatives (including distillate fuel oils) and are projected to remain so for the foreseeable future.

2.2.3.5 Operation and Maintenance

Effective, ongoing operation and maintenance programs can potentially have a larger energy reduction impact than one-time capital investment or repair projects, particularly in highly decentralized consumption situations such as Fort Ord. A per-square-foot reduction of over 11 percent from 1975 to 1980 can be attributed primarily to such programs. Field survey observations and subsequent analyses indicate that a large savings potential still exists in this area. Even if such were not the case, continuation of existing programs would be essential to maintain the reductions previously realized. Constant diligence is required to avoid slipping back into old ways.

Although the scope of work of the present study emphasizes one-time projects rather than ongoing programs, several specific recommendations regarding the latter are offered in this report.

2.2.4 Energy Plan Summary

Due to the decentralized character of energy use and the mild climate at Fort Ord, few opportunities exist for large-scale capital investment projects to reduce energy consumption. A diversified mix of small and medium sized projects combined with an aggressive, ongoing operation and maintenance program is recommended as the optimum strategy.

ECIP projects developed in this study will, if implemented, save an estimated 104,861 MBtu (cost savings: $790,900) annually, representing about 4.8 percent of the current installation consumption. Total construction cost of these projects is $1.54 million. Maintenance, repair, and minor construction projects developed have a total annual

savings of 29,731 MBtu (cost savings: $142,000), or 1.4 percent of the 1980 consumption. Cost to implement these projects is $362,000. Savings due to effective operation and maintenance programs, while difficult to quantify, can potentially be larger than the savings from one-time projects.

The FORSCOM energy reduction goal of 20 percent (on a per-square-foot basis) from 1975 to 1985 has been more than 70 percent achieved and will easily be surpassed using the strategies recommended. The goal of a 25 percent reduction in absolute energy consumption does not appear feasible at Fort Ord because the building square footage is expected to grow by some 38 percent during this ten year period.

SECTION 3

SUMMARY OF RESULTS - PRESIDIO OF MONTEREY

3.1 EXISTING ENERGY CONSUMPTION

3.1.1 Field Survey Conclusions

The most serious energy conservation problems observed during the field survey at the Presidio included lack of heating schedules, overheating of buildings (due to faulty thermostats or other controls), and poor building insulation, and inadequate boiler controls. Other specific problems are documented in this report.

On the positive side, building occupants demonstrated a serious concern for energy conservation and few examples of improper thermostat settings or excessive lighting were seen where occupants had control over these functions. In fact, overheating problems were almost nonexistent where occupants had control, in contrast to "automatically" regulated buildings where some problems were found. Most large heating systems feature energy saving features such as reset of hot supply water temperature with ambient temperature or damper/economizer controls. Substantial improvements in monitoring and control of heating, especially scheduling and night setback features, will be provided by the Energy Monitoring and Control System (EMCS) currently being installed.

Most heating plants observed were reasonably clean. In particular, maintenance of high-pressure boilers appears to be very good, including

water treatment, blowdown procedures, routine adjustments, and records kept. The potential usefulness of these records is diminished, however, by old and inaccurate (or nonexistent) meters and gages.

3.1.2 Historical Energy Use and Costs

Annual energy use from all sources for the past four years at the Presidio is presented in Figure 3-1 and summarized (with costs) in Table 3-1. Figure 3-2 illustrates the consumption trends from FY75 to FY80 in comparison to the FORSCOM energy reduction goals ("target" lines in Figure 3-2). Population and building square footage trends are shown for reference. The 1980 reduction of 4.9 percent per square foot, while significant, is behind target. The absolute consumption has remained nearly constant, while square footage has grown about 4 percent from FY75 to FY80.

3.1.3 Disaggregate Energy End Use

A computer program was developed during this study to calculate annual heating consumption for each building audited and project totals for groups of repetitive buildings. An information summary from this program is presented in Table 3-2. Two indicators of relative energy consumption level are listed: (1) "Percent Total Use," which can be compared with "Percent Total GSF" (gross square feet) ("total" refers to the installation total); and (2) "Energy Utilization Index" (EUI), which gives the ratio of annual consumed Btu's to gross square feet for the building type represented. These figures provide a detailed picture of where energy is being consumed at the Presidio and the relative energy intensity levels of various building types.

In Table 3-3, computed energy consumption is subdivided into four major categories for each building and for the installation as a whole.

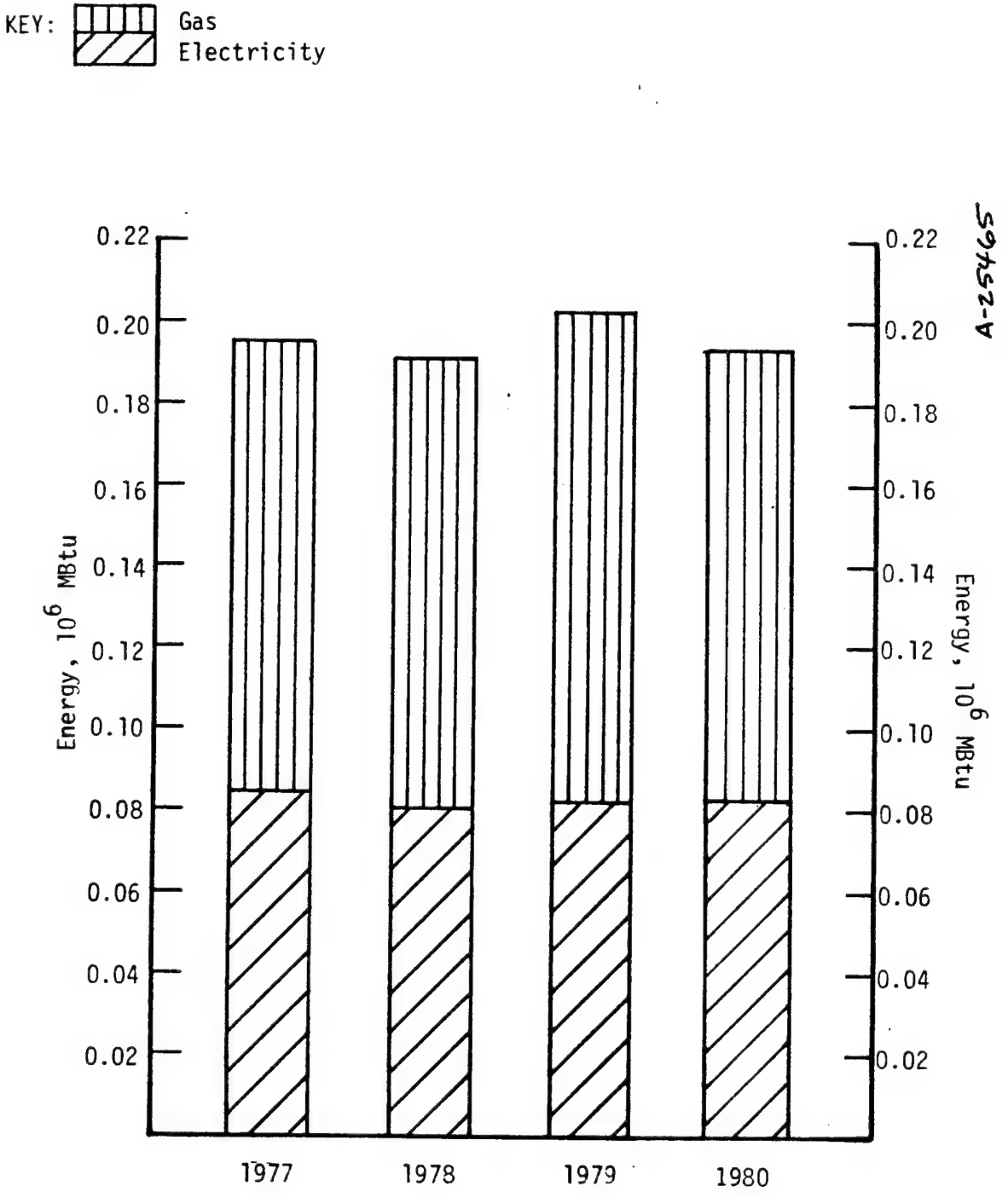

Figure 3-1. Presidio of Monterey Annual Energy Use

Table 3-1. Presidio Of Monterey Annual Energy Use and Costs[a]

Year	Electricity		Natural Gas		Total	
	Use (MBtu)	Cost ($000)	Use (MBtu)	Cost ($000)	Use (MBtu)	Cost ($000)
1977	84,485	280.5	110,963	236.0	195,448	516.5
1978	80,179	282.4	111,573	257.7	191,752	540.1
1979	80,291	234.9	122,641	328.0	202,932	562.9
1980	83,369	363.5	112,959	422.6	196,328	786.1

[a]All energy units are MBtu and the following conversion factors were used: 1 kWh = 11,600 Btu; 1 therm = 0.1 MBtu

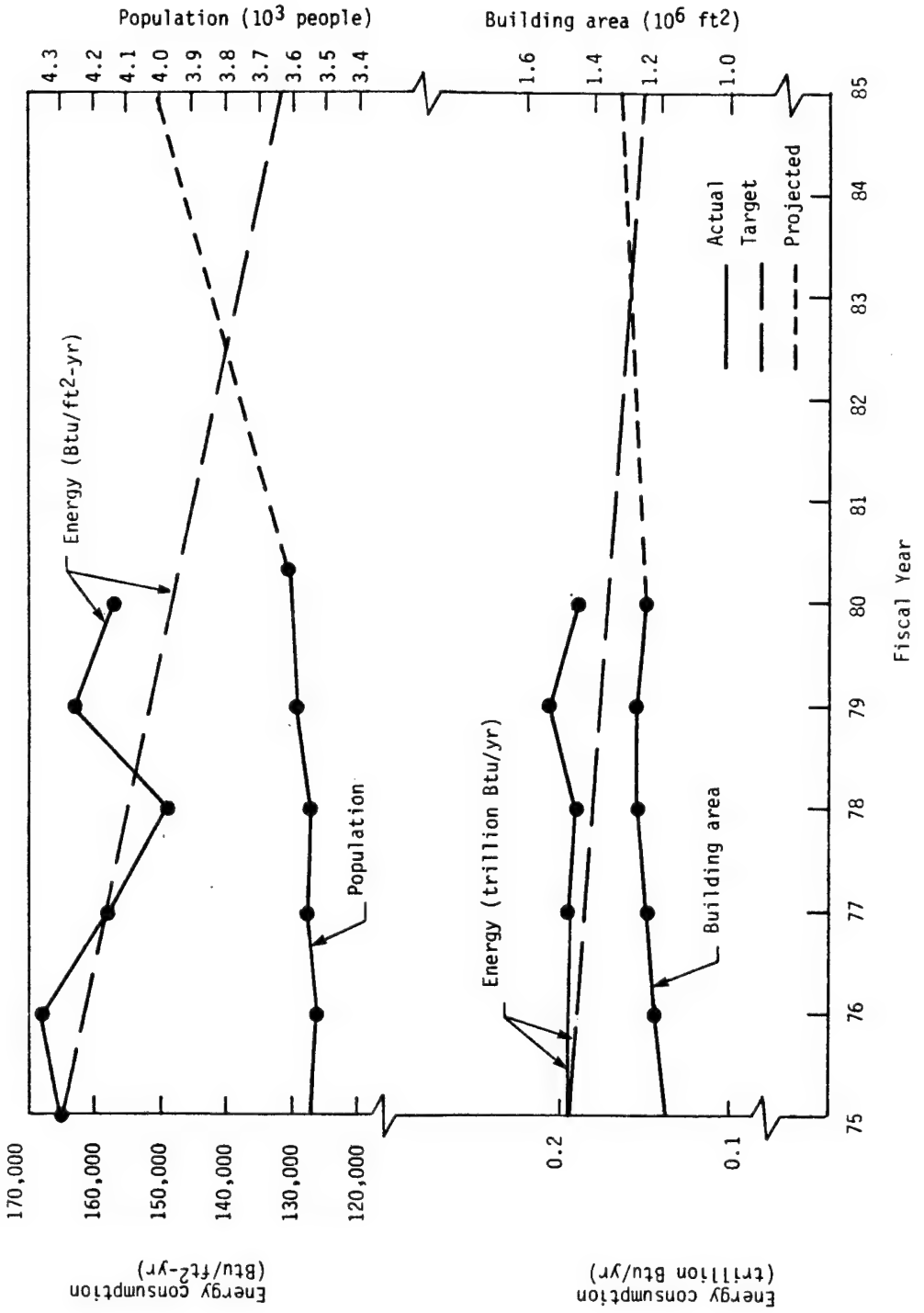

Figure 3-2. Annual Utilities Consumption for Presidio Of Monterey

Table 3-2. Information Summary - Energy Use in Buildings

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PRESIDIO OF MONTEREY ENERGY SURVEY
INFORMATION SUMMARY

BLDG NO	Type*	GROSS SQUARE FEET REPRESENTED GSF	% TOTAL GSF	PROJECTED ENERGY USE (MEGA BTU / YR) FUEL	ELECT	TOTAL	% TOTAL USE	ENERGY UTILIZATION INDEX (BTU/GSF/YR)
422		24621.0	1.97	1900.2	3480.0	5380.2	2.34	218518.8
619		27941.0	2.23	1245.7	3155.2	4400.9	1.92	157506.1
620	A	76634.0	6.13	6953.6	4697.9	11651.5	5.07	152048.6
621	B	75320.0	6.02	6016.6	9204.2	15220.8	6.62	202081.5
622		75891.0	6.07	11445.0	3781.6	15226.6	6.63	200638.0
627	C	246575.0	19.71	29636.9	15283.6	44920.5	19.55	182177.8
TOTAL		526982.0	42.1	57198.0	39602.9	96800.9	42.1	183688.3

* Applies to repetitive buildings only. Letters correspond to letters worked in right-hand margin of Installation Building List (Appendix A).

Table 3-3. Computed Energy Use in Major Categories

Building Number	Function	Projected Annual Energy Use (MBtu)				
		Heat	Other Fuel	Lighting	Other Electricity	Total
422	Medical-dental	1,630	270	1,229	2,251	5,380
614	Administration	1,109	137	1,566	1,589	4,401
620	Instruction	3,415	190	2,262	174	6,042
621	Instruction	2,143	412	1,751	2,158	6,465
622	Troop housing	6,490	4,955	2,297	1,485	15,227
627	Troop housing	5,216	4,434	2,738	2,238	14,626
Projected Totals	Installation	87,000 (38%)	48,000 (21%)	53,000 (23%)	41,000 (18%)	230,000 (100%)

Computed costs per gross square foot in 1980 for the four categories above are presented in Table 3-4.

Table 3-5 presents a summary of annual energy consumption and cost data for the Presidio water pumps.

A summary of computed disaggregate energy end use components at the Presidio is presented in Table 3-6. Buildings consume over 99 percent of the total. Actual 1980 energy use is shown for comparison.

3.2 ENERGY PLAN

3.2.1 ECIP Projects

ECIP projects developed during this study are discussed briefly here, in order of descending E/C ratio. Numerical data are given in Table 3-7.

1. Install waterflow restrictors (non-family housing) -- These devices reduce flow rate substantially resulting in very large savings in hot water usage as well as electricity for pumping water.
2. Install waterflow restrictors (family housing) -- Same as above.
3. Expand EMCS -- This project is required to provide scheduling of heating in eight academic buildings which are currently heated 24 hours per day.

Table 3-7 contains a summary of information for all previous and proposed Fort Ord ECIP projects and shows how they help meet the FORSCOM goals. Projects developed during this study are for FY84 and are ranked by energy-to-cost (E/C) ratio. The total computed annual energy savings from these projects is 13,886 MBtu (annual cost savings at projected FY84 prices: $130,900). Total construction cost is $164,000.

Table 3-4. Estimated Annual Costs per Gross Square Foot (GSF) for Various Energy Use Categories in 1980

Category	Energy 10^9 Btu	MBtu per GSF	Cost per MBtu[1] ($)	Cost per GSF ($)
Heating	72.7	0.0582	4.44	0.258
Other fuel	40.2	0.0321	4.44	0.143
Lighting	44.0	0.0352	5.12	0.180
Electricity	34.4	0.0275	5.12	0.141
Total	191.3	0.1530	4.72	0.772

[1]Based on October 1980 prices as follows:
Natural gas: $4.44/MBtu
Electricity: 5.94¢/kWh = $4.74/MBtu

Table 3-5. Presidio Water Pump Data

Pump ID	Type	Motor (hp)	Flow (gpm)	Head (ft)	Motor Load Factor	Overall Efficiency[a]	Hours Operated	Quantity (million gallons)
Lower Booster 1	Centrifugal	50	301	441	0.85	0.70	4,493	73.47
Lower Booster 2	Centrifugal	40	283	400	1.01	0.63		
Upper Booster	Centrifugal	Unk	--	--	--	--	404	

[a]System (pump/motor)

Table 3-6. Summary of Presidio of Monterey Disaggregate Energy End-Use

Category	Annual Energy Use (10^9 Btu)			
	Fuel	Electricity	Total	Percent Installation Use
Buildings				
Heating	87		87	37.7
Other fuel	48		48	20.8
Lighting		53	53	22.9
Other Electricity		41	41	17.7
Buildings -- total	135	94	229	99.1
Water pumps		2	2	0.9
Total projected	135	96	231	100
Actual use 1980	108	83	191	--

The column in Table 3-7 entitled "Percent Reduction per Ft^2" indicates the contribution of each project to this goal, while the column entitled "Percent Goal Remaining" indicates how much of the 20 percent goal remains to be accomplished after implementation of each project. While there are no very large-scale projects listed in Table 2-10, it is evident that the 20 percent reduction per square foot by 1985 can nearly be achieved through ECIP projects alone. The second goal of a 25 percent reduction in the absolute level of energy consumption is not likely to be realized at the Presidio because of the continuing expansion of both population and building square footage. A 1 percent energy reduction occurred from 1975 to 1985 in spite of a 4 percent growth in square footage. Based on reductions due to proposed ECIP projects only, the total 1985 consumption is projected to be 177 billion Btu/yr, a growth of 11 percent from the 1975 level of 198 billion Btu/yr. The square footage will have grown by 11 percent during this same period, however.

It is well to note that a per-square-foot energy reduction of nearly 5 percent occurred between 1975 and 1980 without any ECIP projects. This reduction has occurred as a result of factors which are primarily operational in nature and include the following:

- An aggressive program of energy conservation by the DFAE Energy Branch, including the "roving inspector" system.
- Construction of new, energy efficient buildings.
- Demolition of old wooden buildings or conversion of these to functions requiring fewer hours of heating.

All of these factors will continue to provide energy consumption reductions through 1985. Thus the 1985 energy consumption is expected to be significantly lower than shown in Table 3-7.

Table 3-7. ECIP Summary

FY	Building Area (10^6 sq ft)	Project or Status	Cost ($K)	E/C	B/C	Payback (yr)	Energy Reduction			Energy Consumption			Percent Energy Reduction	Percent Goal Remaining
							MBtu/Yr	$K/yr	Btu ft^2-yr	10^{12}Btu yr	$K/yr	Btu ft^2-yr		
75	1.20	1975 Status	--	--	--	--	--	--	--	0.198	0.283	165,000	0	20
80	1.25	1980 Status	--	--	--	--	--	--	--	0.196	786.1	157,000	4.85[1]	15.15
81	1.25	Energy Monitoring and Control System (EMCS)	329	51.0	3.42	--	16,825	90.0	13,460			143,540	8.16	6.99
84	1.33	Install Waterflow Restrictors (Non-Family Housing)	7	1,569	173	0.1	10,671	104.0	8,023			135,517	4.86	2.13
84	1.33	Install Waterflow Restrictors (Family Housing)	1	671	74.1	0.2	915	8.9	688			134,829	0.42	1.71
84	1.33	Expand EMCS	156	14.8	1.40	8.7	2,300	18.0	1,729			133,100	1.05	0.66
85	1.33	1985 Status[2]	--	--	--	--	--	--	--	0.177	1,366.8	133,100	19.34[4]	0.66
Summary of 1984 ECIP Projects			164				13,886	130.9	10,440				6.33	

[1]Cumulative through FY80 -- includes non-ECIP reductions
[2]Based on reductions from ECIP projects only
[3]Estimate based on 14% annual growth rate in unit energy costs from FY80-85
[4]Cumulative through FY85 based on ECIP projects only

3.2.2 Maintenance, Repair, and Minor Construction Projects

Tables 3-8 and 3-9 present information on projects developed for buildings and systems, respectively.

Projects have been developed for 1981 and therefore are based on current (unescalated) costs. Projects are ranked by B/C ratio; those with B/C below 1.0 are listed but their energy savings are not included in the totals. The total annual energy savings for all projects with B/C greater than 1.0 are 4,721 MBtu (cost savings: $21,000). This is equivalent to 2.2 percent of the 1975 baseline cost of implementing these projects is $175,000.

Several of the minor construction projects listed in Tables 3-8 and 3-9 satisfy the minimum E/C and B/C requirements for 1984 ECIP funding, although none meet the $100,000 minimum cost when considered alone. It must also be remembered that the E/C ratios for these projects are for 1981; 1984 values would be lower due to construction cost escalation.

3.2.3 Additional Recommendations

Recommendations other than ECIP, maintenance, repair, and minor construction projects but important to the installation energy reduction plan are discussed in this subsection.

3.2.3.1 Load Shedding

Because of the distributed character of energy use, no significant load shedding opportunities exist at the Presidio.

3.2.3.2 Metering of Individual Buildings

Most buildings at the Presido are not individually metered. Metering allows precise tracking of energy use and improved accountability. Installation of individual gas and/or electrical meters is recommended for two mess halls (buildings 629 and 630) which cannot be

Table 3-8. Maintenance, Repair, and Minor Construction Projects (Buildings)

Project	Cost ($K)	Energy Savings (MBtu/yr)	Energy Cost Savings ($ K/yr)	B/C	E/C (MBtu/$K)	Man-Hours
A. Maintenace and Repair						
1. Replace Standard Electric Motors with Energy-Efficient Motors	5.7	78	0.4	0.82	14.0	23
B. Minor Construction						
2. Install Foam Caulking	8.2	778	3.5	5.23	94.9	130
3. Install Waste Heat Recovery Units in Mess Halls	3.5	85	0.4	2.05	24.4	32
4. Weatherstrip Windows	60.8	1,960	8.7	1.24	32.2	1,323
5. Insulate Walls in Family Housing	67.5	1,112	4.9	1.16	16.5	1,173
Totals(projects with B/C > 1.0 only)	140.0	3,935	17.5			

Table 3-9. Maintenance, Repair and Minor Construction Projects (Systems)

Project	Cost ($K)	Energy Savings (MBtu/yr)	Energy Cost Savings ($K/yr)	B/C	E/C (MBtu/$K)	Man-Hours
A. Maintenance and Repair						
None						
B. Minor Construction						
Replace boiler burners and control systems	34.7	786	3.5	1.25	22.7	230

monitored by EMCS or other existing means. Meters for the boilers in building 627 are also recommended to permit accurate evaluation and optimization of boiler and steam distribution system operations.

3.2.3.3 Waste Fuels

Untreated solid waste has the potential to meet nearly 10 percent of the Presidio's fuel requirements but would require the installation of new boilers capable of firing a solid fuel. Pyrolysis of solid waste could supply about 4 percent of the Presidio's fuel needs, but pyrolysis systems are still in the development stage.

3.2.3.4 Future Fuel Choices

Based on economic considerations, natural gas must continue to meet most of the Presidio's fuel needs for the foreseeable future (as at Fort Ord).

3.2.3.5 Operation and Maintenance

Effective, ongoing operation and maintenance programs can potentially have a larger energy reduction impact than one-time capital investment or repair projects, particularly in highly decentralized consumption situations such as the Presidio. A per-square-foot reduction of 5 percent from 1975 to 1980 can be attributed primarily to such programs. Field survey observations and subsequent analyses indicate that a large savings potential still exists in this area. Even if such were not the case, continuation of existing programs would be essential to maintain the reductions previously realized. Constant diligence is required to avoid slipping back into old ways.

Although the scope of work of the present study emphasizes one-time projects rather than ongoing programs, several specific recommendations regarding the latter are offered in this report.

3.2.4 Energy Plan Summary

Due to the decentralized character of energy use and the mild climate at the Presidio of Monterey, few opportunities exist for large-scale capital investment projects to reduce energy consumption. A diversified mix of small and medium sized projects combined with an aggressive, ongoing operation and maintenance program is recommended as the optimum strategy.

ECIP projects developed in this study will, if implemented, save an estimated 13,886 MBtu (cost savings: $130,900) annually, representing about 7.1 percent of the current installation consumption. Total construction cost of these projects is $164,000. Maintenance, repair, and minor construction projects developed have a total annual savings of 4,771 MBtu (cost savings: $21,000), or 2.4 percent of the 1980 consumption. Cost to implement these projects is $175,000. Savings due to effective operation and maintenance programs, while difficult to quantify, can potentially be larger than the savings from one-time projects.

The FORSCOM energy reduction goal of 20 percent (on a per-square-foot basis) from 1975 to 1985 cannot be achieved by ECIP projects alone, but can be realized through the diversified strategy recommended. The goal of a 25 percent reduction in absolute energy consumption does not appear feasible at the Presidio because the building square footage is expected to grow by some 11 percent during this ten year period.

SECTION 4

ECIP PROJECT PROGRAMMING DOCUMENTS

Programming documents were prepared for all ECIP projects developed in this study and are contained in Volume IV. Although a total of 15 individual projects were developed for Fort Ord and 3 for the Presidio of Monterey, many of these are small projects which do not satisfy the minimum cost criteria for ECIP funding ($100,000). In some cases, parallel projects were developed for both installations (for example, expansion of EMCS). For these reasons, groups of projects were formed from some individual projects, resulting in a final total of 10 ECIP projects, all of which meet the ECIP funding criteria.

Programming documents prepared for each group include:

- Form DD 1391 (with Economic Analysis) for the group as a whole
- Forms DD 1391 (with Economic Analyses) for all individual projects in the group
- Detailed Justification and Project Development Brochure (PDB) for the group as a whole

Programming documents for each single (uncombined) project consist of Form DD 1391, Economic Analysis, Detailed Justification and PDB.

The final 10 ECIP projects are listed in Table 4-1, with project groupings identified. A summary of energy savings and economic

Table 4-1. ECIP Project Groupings

Project	Cost ($K)	Energy Savings (MBtu/yr)	Cost Savings ($K/yr)	E/C	B/C	Payback Period (yrs)
1. a) Install waterflow restrictors, family housing (Fort Ord) b) Install waterflow restrictors, family housing (Presidio of Monterey) c) Insulate family housing hot water tanks (Fort Ord) Group Totals	79	39,689	231.9	505	36.2	0.3
2. a) Install waterflow restrictors, nonfamily housing (Fort Ord) b) Install waterflow restrictors, nonfamily housing Presidio of Monterey) c) Install foam caulking in temporary buildings (Fort Ord) Group Totals	131	43,747	355.9	330	32.0	0.4
3. Convert to infrared and small unit heaters (Fort Ord)	114	5,456	41.5	47.7	3.15	2.8
4. a) Convert to Island Cases with Satellite Ice Cream (Fort Ord) b) Install atmospheric desuperheating/subcooling coil (Fort Ord) c) Install microprocessor-based energy controller (Fort Ord) Group Totals	151	5,538	44.2	36.9	2.45	3.4
5. a) Insulate laundry pipes, presses and dryers (Fort Ord) b) Insulate bare pipes (Fort Ord) Group Totals	133	4,319	32.8	32.5	2.14	4.0

Table 4-1. Concluded

Project	Cost ($K)	Energy Savings (MBtu/yr)	Cost Savings ($K/yr)	E/C	B/C	Payback Period (yrs)
6. a) Expand energy monitoring and control system (Fort Ord) b) Expand energy monitoring and control system (Presidio of Monterey) Group Totals	527	11,641	124.5	22.1	2.93	4.2
7. Convert incandescent interior lighting to fluorescent (Fort Ord)	103	1,587	13.4	15.4	1.49	7.7
8. Install swimmimg pool solar heating system (Fort Ord)	143	2,191	16.6	15.2	1.44	8.7
9. Convert incandescent street lights to HPS, nonfamily housing (Fort Ord)	102	1,444	19.5	14.3	1.92	5.2
10. Convert incandescent street lights to HPS, family housing (Ford Ord)	220	3,135	41.3	14.3	1.89	5.3
Total For All Projects	1,703	118,747	921.6			

information, including energy-to-cost (E/C) and benefit-to-cost (B/C) ratio, is presented for each of the 10 projects. Projects are listed in order of descending E/C ratio.

The total annual energy savings projected from these 10 projects is 118,747 MBtu; this represents 5.0 percent of the total 1980 energy consumption at the two installations. The total annual cost savings is $921,900. Total construction cost is $1.7 million.

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ENERGY AUDIT SURVEY

Utilization Hours _____

_____

Population (note different pops for different times of day for special use)

_____

_____

_____

Building Size: Length _____ ft

Width _____ ft

Height _____ ft/story

No. stories _____

Window areea _____ ft^2/story

Construction Materials: (Make notes on sketch as needed)

Walls _____

Roof _____

Ceiling _____

Floors _____

Doors _____

Outside walls _____

Comments:

Sketch building below, indicating N. Add brief building description (construction type, special or novel characteristics, etc., as needed).

LIGHTING INVENTORY

Room or Area	Type and no. lamps	Watts/lamp	Hrs/day used	Control Method (Wall switches, breaker panel timeclock, etc.)

Heating Data

Type of domestic hot water heater and rating:
(i.e., gas, and electric, 100,000 Btu/hr, etc.)

Space heating:

a. Type of space heating

b. Transport media

c. Heat exchanger surface

d. Comments

SPECIAL ENERGY USERS

(Fans, pumps, window air conditioners, deep fat fryers, etc.)

Description	Rating (hp, ton, Btu, etc.)	Hours of Operation (hrs/wk)	Timer Controlled	Remarks

Special comments for the building: (e.g., Room 42 is overlit, too hot, no controls on lights, etc.)